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The Standardization Work of the Detroit Edison Company

by

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Standards Catalog

Inspection of materials; perpetuation and enforcement of standardization; benefits and accomplishments of standardization; classification of materials

The story of the standardization work of the Detroit Edison Company, the first two parts of which were published in the February and March issues of the ASA BULLETIN, is concluded in the following pages.

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Inspection of Materials

The previous chapters have dealt only with the problems met in attempting to properly select and specify the materials desired. This chapter describes the group which was created expressly to see that these materials are received in accordance with the descriptions written on the purchase orders.

Organization—The division whose function it is to inspect new materials which have been purchased is composed of several electrical and mechanical engineers. All of these men have previously had enough field experience to acquaint them with the practical application of the materials they are called upon to inspect. The group is headed by the Chief Inspection Engineer.

Purpose—Primarily, the purpose of this group is to make sure that the material is received as specified on the purchase order. In other words, this group was formed to make sure that the company gets what it pays for. Functionally, its chief concern is to determine whether or not the material received conforms to the specifications as stated on the purchase order. In all cases the purchase order either adequately describes the item directly, or refers to a purchasing specification, or names a standard product of a manufacturer.

Routine—The routine of inspection involves the comparison of the material furnished by the vendor with the specifications as listed on the purchase order. The examinations may go only so far as a visual inspection, such as would determine satisfactorily the uniformity of a galvanizing coat. Also, the general appearance of an item is a criterion of the workmanship. The inspection may extend as far as complete tests such as those conducted on high-voltage underground cable. These tests are conducted at the manufacturers' plants and at the Electrical Testing Laboratories. Where these types of inspection will not suffice, or are not practicable, samples are obtained and sent to the Research Laboratories for the determination of physical characteristics or chemical properties, as the case requires. However, in all cases the inspector is guided by the description of the item appearing on the purchase order and by the drawings and specifications which, where required, are attached and incorporated as a part of the order. By maintaining constant contact with the warehouses and other receiving points in the company, the inspectors are able to investigate many of the items as they are received. However, a great many items are inspected at the manufacturers' plants.

Testing—As part of the routine inspection of materials, samples are tested at periodic intervals at the Research Laboratories of the company. These samples are procured by the inspectors, and the tests are carried on by the research engineers. Listed among these tests are those to determine the resistance to corrosion of protective coatings, strength and ductility of steel, dielectric properties of friction tape and insulating oils, chemical analysis of alloys and compounds, microphotographic examination of the grain structure in heat-treated castings, and the physical properties of cement.

Allowable tolerances—An important consideration for an inspector is the matter of allowable tolerances. He is not vitally concerned with the fact that a dimension does not check exactly unless the deviation from exactness exceeds the permissible variation. Obviously, a thorough knowledge of this company's practice with respect to tolerances is exceedingly important to an individual who is checking the dimensions

of an item. In order that the vendor may familiarize himself with this information, the purchase order or specification should tell the whole story.

Initiation of inspections—Inspections are initiated at the request of any individual or department within the company interested in the quality of any specific item being purchased. In the case of many items the requests develop into standing assignments. As a matter of routine, the orders each day are examined in the Inspection Division. Those orders are selected which, in the judgment of this group, need inspection. Also, many orders are selected for inspection by the Inspection Division because of the possibilities of obtaining valuable information.

Extent of inspection—The items which are regularly inspected include more than half of the total purchases of this company. An idea of the diversity of the materials included in this group of inspected items may be gained when one considers that it covers fabricated steel, line hardware, poles, cross arms, high-voltage cable, valves, pipe, pipe fittings, copper wire and bus bar, castings, building materials, and mechanical equipment such as pumps, condensers, and boilers.

Rigid inspection of materials meets with the hearty approval of the better class of vendors. Reputable manufacturers are thus assured that they are not competing in price with products of inferior quality.

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Perpetuation of Standardization

The previous chapters reveal that a great deal of effort has been expended to create appropriate standards. If they are to be of lasting benefit, some system of keeping them up-to-date is necessary. A policy relative to the perpetuation of the results of standardization has been established. This chapter describes what steps have been taken up to the present time to insure the continuance of the desirable results.

Procedure

The subcommittees responsible for the standardization of the various classes of materials were not disbanded at the completion of their original reports but, rather, they were held on an inactive status. At the end of six months the standards engineer, who was assigned to the subcommittee from the Standards Group, reviewed the Master Standards Catalog File. From these records he compiled two lists of items. The first list contains non-standard items purchased since the completion of the original report. The second list contains those items which were declared standard but had not been purchased at all or so infrequently as to create doubts of the advisability of continuing them as standard. With these two lists as ammunition, the subcommittee reconvened to review their original report.

It is planned to follow this same procedure at regular intervals. A review of each class of material in the Master Standards Catalog File will disclose whether or not it is advisable for the subcommittee to reconvene.

Subcommittee action

Non-standard items—The list of non-standard items is studied very carefully and the requisitioners of them are interviewed. It often develops that a standard item would have sufficed if the individual had been aware of its existence. In such a case no further subcommittee action is required.

Next, it is important to ascertain if the item will be required regularly in the future. It is possible that a single order was placed to procure the item for experimental purposes only. If such was the case, a definite answer could be obtained only if the tests were completed. In the event that they were not, a final decision would be delayed until the next revision meeting of the subcommittee. The item may have been obtained for some isolated job that might never recur. In this event, further consideration would not be necessary.

However, a real need for the item may have arisen. If substitution of a standard item is impossible, and the item is one that will be required regularly, a study is undertaken to determine whether or not the item purchased is the best for the service intended.

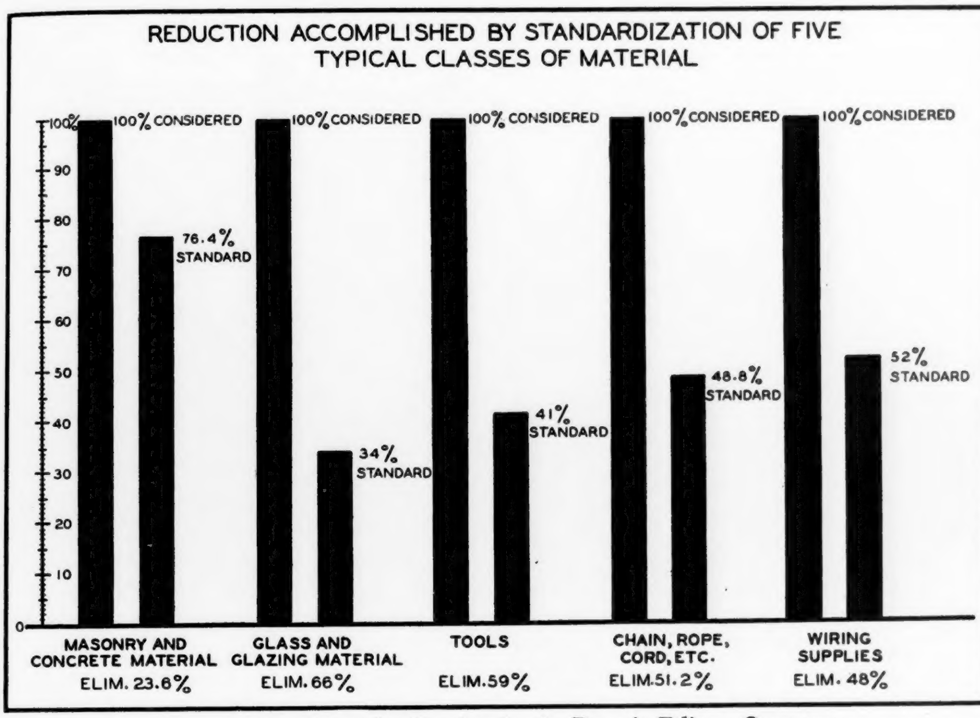
Whatever item proves to be superior after all factors have been considered is adopted as a standard.

Obsolescence of standards—In the case of standard items which are being used less frequently as times goes on, or have ceased to be required, the original sponsors are interviewed with a view to eliminating the items. There are several sufficient reasons why such a condition would exist. A change in structural or engineering design, the discovery that another standard item is better for the job than the item in question, or the use of an improved product as a substitute are among the possible reasons for the decline in popularity of a standard item.

The people who are qualified to inform the subcommittee members on this question are the users of the material. If it is not going to be used in the future, the item is dropped as a standard.

New and improved products—Buyers, engi-

neers, and designers alike are besieged by salesmen selling new devices. Into most of these have gone inventive genius and a great deal of thought. Most of these new products have



Some results of standardization in the Detroit Edison Company

merit. Whether or not they should be adopted as standard for use within our company is largely a question of adaptability to our service.

While every precaution should be exercised to prevent standardization from stifling initiative, an intelligent restraint should be placed upon indiscriminate, ungoverned selection and purchase of every new device which is placed on the market.

A workable procedure is to have the individuals who believe these new or improved products will find useful and economical application in our service invite the subcommittee members' attention to them. If it is the consensus of opinion that such an action is warranted, an investigation can be instituted to determine the characteristics of the new item. This plan has the advantage of having the results of the investigations in a central bureau where all may have access to them. This system prevents innumerable private tests which are only partially done, are inaccurate, not available to all, expensive, and in most cases are a duplication of effort.

If the new or improved product proves acceptable, it is adopted and substituted for the previous standard. In the event that it is not satisfactory, a definite answer is available.

Clearing house for information—There has been a tendency on the part of various departments to use the Standards Group as a central bureau or clearing house for information relative to the standardization of materials. All suggestions received are written out and filed with the subjects to be presented at the next meeting of the subcommittee concerned. An abundance of these suggestions would be justification for a chairman to call a meeting of his group to review the ideas presented. The Standards Group is ideally organized to perform this service for the subcommittees in that its representatives contact all groups regularly.

Enforcement of standardization

There has recently been established a system designed to promote the use of standard items as well as to discourage and regulate the use of non-standard materials. The problem is largely one of instructing requisitioners in the proper use and significance of the *Standards Catalog*. A positive solution of the problem was purposely deferred until such time as enough of the approved standards were published to warrant insisting on adherence to them. However, recently the Main Committee assigned to the Publishing Subcommittee the task of devis-

ing a workable procedure for this enforcement.

Several plans were considered. The basis for all of them was the consideration that an individual should not have to await the action of any subcommittee in order to procure a non-standard item. Neither should any one be permitted arbitrarily to order at random materials not standard with the Detroit Edison Company.

As an original premise it was conceded that under certain circumstances the use of non-standard items was not only unavoidable but desirable. The newly established enforcement system aims not at the complete elimination of the use of non-standards but rather at their indiscriminate use. This curtailment has been accomplished by making the requisitioners in each case justify the order.

The routine set up within this company for the procurement of materials provides that all requsitions clear through the Stores Department. Under the enforcement plan an individual in this group will determine whether or not the desired material is standard. If not, the requisition will be stamped "Not Detroit Edison Standard." When a requisition so stamped reaches the buyer in the Purchasing Department he is required to notify the following individuals that the item ordered is non-standard:

1. The requisitioner
2. The head of the requisitioner's department
3. The chairman of the appropriate subcommittee

The latter is charged to investigate the merits of the item with a view to determining whether or not it should be included as a standard. The Standards Catalog Group are notified of the subcommittee's final decision. The purchase of the desired item is not, however, delayed pending the outcome of the investigation by the subcommittee. A great deal of leniency is purposely shown in this respect in order to eliminate any tendency toward stereotyping design. However, the Main Committee does insist that the ordering of non-standard items shall not be unlicensed and ungoverned. The indiscriminate ordering of these "outlawed" items is not compatible with proper standardization.

This system has been inaugurated to invite the requisitioner's attention to the fact that he is asking for material which previously the subcommittee had considered was unnecessary. The system does not introduce insurmountable obstacles in the way of securing non-standard items but it does provide a reasonable check when properly applied.

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Benefits Derived from Standardization

The benefits derived from standardization, both realized and expected, are many and varied. Directly or indirectly all of these benefits can be listed as a saving of needless expense. The savings are both tangible and intangible.

At the risk of subjecting the reader to a certain amount of repetition or duplication of information previously presented, some of these benefits are seriately listed below.

Benefits

1. Reduction of excessive stocks of materials and replacement parts
2. Reduction of the number of items carried in stock
3. Elimination of slow moving and stagnant stock items
4. Minimizing "private stocks" of material and supplies
5. Prevention of duplication of stock items
6. Reduction of capital invested in stocks
7. Reduction of varieties of items
8. Reduction of sizes of items
9. Fewer specially designed items
10. Orderly introduction of new material
11. Orderly retirement of obsolete material
12. Elimination of items too good for the job
13. Reduction of trade-named items
14. Less lost motion in purchasing and requisitioning
15. Fewer incorrect shipments of goods
16. Less time lost in shipment
17. Fewer purchase orders
18. Well regulated buying of definite quantities of stock items at periodic intervals
19. More general quantity buying
20. Greater latitude afforded buyer because of a wider use of the proper terminology for items
21. The buyer is enabled to know exactly what he is buying
22. Establishment of standard nomenclature
23. Establishment of adequate specifications
24. Fewer discrepancies in inventories
25. Correct descriptions on purchase orders
26. Less time lost in placing orders
27. Real inspection of materials is made possible
28. Reduction of bookkeeping
29. Establishment of a classification of materials and equipment for all departments

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Interesting Experiences and Accomplishments of Standardization

Throughout the preceding eleven chapters

reference has been made in many places to the various results of standardization and the methods used in its accomplishment. In only a few instances, however, were concrete examples included. Because it is believed that these experiences and accomplishments will prove especially interesting to the reader, some of them have been included in this chapter.

The experiences and examples of types of standardization herein presented represent only a small fraction of those available for inclusion. They were chosen more or less at random. Each illustration, however, is worthy of mention in this story of industrial "cost reduction" and "savings," with Standardization cast in the leading character role.

The following examples of the various types of standardization are grouped under the headings with which the reader of this article has previously become familiar.

Reduction of sizes and types

Outlet boxes—A considerable number of outlet boxes are purchased regularly by the company. However, due to the wide range of sizes and types which were indiscriminately selected, the number of boxes per order was relatively small. The Wiring Supplies Standardization Subcommittee reduced the number of these items from 41 to 6, a curtailment of 85 per cent. Because of this reduction of the number of items purchased and the corresponding increase in the quantity of each standard box used, the buyer was able to purchase in greater quantities. A net saving of 25 per cent of the previous cost was accomplished.

Glass—The subcommittee responsible for the standardization of glass achieved the following results with respect to the elimination of sizes and items:

Kind	*Total sizes and items prior to standardization*	*Number of sizes and items eliminated*	*Per cent of elimination*
Sheet glass	300	142	47
Polished plate glass	145	127	88
Obscure glass	83	56	67
Wire glass	210	156	74
Mirrors	28	27	96
Total	766	508	66

Tools—As an example of the reduction in the number of items which are regularly purchased in any class of material, the statistics on "tools" are interesting. There were 7088 items considered, of which 4175 items (59 per cent) were eliminated. Certainly among the 2913 items (41 per cent) remaining as standard there will be many opportunities for the consolidation of purchases. In turn, a real saving in paper work must accrue.

Reduction of sizes

Machine reamers—Machine reamers formerly used were of four types. They were purchased over approximately the same range of sizes,

MACHINE REAMERS

	Chucking		Shell			Chucking		Shell	
DIAM	STRAIGHT SHANK	TAPER SHANK	SPIRAL FLUTED	STRAIGHT FLUTED	DIAM	STRAIGHT SHANK	TAPER SHANK	SPIRAL FLUTED	STRAIGHT FLUTED
1/8	●	—	—	—	1 11/32	—	—	○	○
5/32	○	—	—	—	1 3/8	○	○	●	○
3/16	●	—	—	—	1 13/32	—	—	○	○
7/32	○	—	—	—	1 7/16	○	○	●	○
1/4	●	○	—	—	1 15/32	—	—	○	○
9/32	○	○	—	—	1 1/2	○	○	●	○
5/16	○	●	—	—	1 17/32	—	—	—	○
11/32	○	○	—	—	1 9/16	○	○	●	○
3/8	○	●	—	—	1 19/32	—	—	—	○
13/32	○	○	—	—	1 5/8	○	○	●	○
7/16	○	●	—	—	1 21/32	—	—	—	○
15/32	○	○	—	—	1 11/16	○	○	●	○
1/2	○	●	○	○	1 23/32	—	—	—	○
17/32	○	○	○	○	1 3/4	○	○	●	○
9/16	○	●	○	○	1 25/32	—	—	—	○
19/32	○	○	○	○	1 13/16	○	○	●	○
5/8	○	●	●	○	1 27/32	—	—	—	○
21/32	○	○	○	○	1 7/8	○	○	●	○
11/16	○	○	●	○	1 29/32	—	—	—	○
23/32	○	○	○	○	1 15/16	○	○	●	○
3/4	○	○	●	○	1 31/32	—	—	—	○
25/32	○	○	○	○	2	○	○	●	○
13/16	○	○	●	○	2 1/16	—	—	○	○
27/32	○	○	○	○	2 1/8	—	—	○	○
7/8	○	○	●	○	2 3/16	—	—	○	○
29/32	○	○	○	○	2 1/4	—	—	○	○
15/16	○	○	●	○	2 5/16	—	—	○	○
31/32	○	○	○	○	2 3/8	—	—	○	○
1	○	○	●	○	2 7/16	—	—	○	○
1 1/32	○	○	○	○	2 1/2	—	—	○	○
1 1/16	○	○	●	○	2 9/16	—	—	○	○
1 3/32	○	○	○	○	2 5/8	—	—	○	○
1 1/8	○	○	●	○	2 11/16	—	—	○	○
1 5/32	○	○	○	○	2 3/4	—	—	○	○
1 3/16	○	○	●	○	2 13/16	—	—	○	○
1 7/32	○	○	○	○	2 7/8	—	—	○	○
1 1/4	○	○	●	○	2 15/16	—	—	○	○
1 9/32	—	—	○	○	3	—	—	○	○
1 5/16	○	○	●	○	—	—	—	—	—

Chart showing reduction in number of sizes of machine reamers. Solid circles indicate sizes retained as standard; open circles indicate sizes eliminated by standardization

totaling 216 separate items. It was found that these four reamers all were used for the same kind of work and for that reason one series of sizes would suffice instead of four. Some of the types were found to be superior over certain size ranges. As a result of this standardization, 184 items (85 per cent) were eliminated, leaving only 32.

Angle iron—In considering the company's requirements for angle iron, the subcommittee members finally decided upon 75 items as being sufficient to cover all needs. These were nicely graduated in size. Previously, the entire range of sizes had been available for selection by design draftsmen and, as a result, some 250 sizes

had been used. A reduction of 70 per cent in sizes was effected in the case of this item.

Reinforcing steel—The subcommittee which was considering reinforcing steel reduced the available eleven sizes adopted as national standards to nine sizes for this company's requirements.

Steel pull boxes—For the various wiring jobs throughout the company in connection with new and old construction work it was found that 88 different sizes of steel pull boxes were regularly being purchased. Each size in turn was being obtained in two different finishes, black and galvanized. The galvanizing was deemed advisable for installations below the ground line. However, it proved economical to purchase the steel boxes with the black coating for installations above the ground line because of the added cost of galvanizing. After a careful study of all the factors involved, the standardization subcommittee reduced the number of sizes considered adequate for this company's requirements to four. In addition, only the galvanized finish was specified for all sizes. This actually reduced the number of items from 176 to 4. Aside from the economical advantage of being permitted to procure fewer items in greater volume, there was also the intangible saving accruing from less bookkeeping in the Stores and Accounting Departments and less confusion in the Designing and Erection Groups.

The 176 quantity was obtained from a record of purchases for only a short period. The subcommittee found that there were 2230 separate items from which to choose.

Reduction of types

Bit braces—There were originally nine different styles of bit braces being purchased in three different sizes each; a total of 27 different items. These included both ratchet and non-ratchet types with the various combinations of head, jaw, ratchet, and handle. After investigation by subcommittee members, the list was cut down to one type in which two sizes were selected, a total of two items. Net result:—the elimination of 25 items (93 per cent) from a list of 27 items.

Carriage bolts—The line of carriage bolts used by the company was simplified by the adoption of the square neck variety only.

Lag screws—The number of different kinds of lag screws used by the Overhead Lines Construction Group was reduced from 15 to 2.

Mopsticks—The types of mopsticks used throughout the organization were reduced to one.

Bolt anchors—Many types of bolt anchors were used consistently throughout the company. An investigation was conducted by the subcommittee to determine the relative merits of the various varieties. Actual tests which simulated service conditions were made. From the results of these tests one anchor was selected to replace the several dozen types previously used.

Soap—An investigation of the white soap used by the company and three competitive brands revealed that they were practically alike in quality but varied by 60 per cent in the cost per ounce of dry soap. The company had been using the most expensive and is now using the least expensive on this basis.

Reduction in number of stock items

As a direct result of standardization, the number of items carried in stock at the company warehouses has been reduced considerably. The following results were computed after the completion of the work on the first five classes of materials standardized:

Class	*Per cent reduction of stock items*
Builder's hardware	10
Bolts, screws, nails, etc.	37
Fire brick	25
Wire and cable	51
Chemicals	15

Reduction of private stocks

During an investigation to determine the extent of "private stocks," the materials held for future use by individuals in one department were collected. The value of these items aggregated approximately $100,000.

Elimination of trade-named products

Fire-extinguisher liquid—Many fine examples of the substitution of standard specification material for trade-marked items are to be had. At the present time this company is using Federal Specifications Board fire-extinguishing liquid, which was found to be the same as that previously purchased under a brand name. The saving in cost is nearly 50 per cent.

Trolley cord—Prior to the standardization of the rope class of material the company purchased quantities of a trade-named trolley cord. The subcommittee eliminated the trade name as part of the description and specified a water-proofed trolley cord. This resulted in the purchasing of a duplicate product at a saving of 40 per cent in cost. From this one small item an annual saving of approximately $1000 per year is realized.

Pills—In the medical group a quantity of one kind of trade-named pill was being used regularly. By permitting the buyer to procure the

substance under its chemical name from a reputable wholesale drug concern, instead of purchasing the proprietary named item, approximately 70 per cent of the previous cost was saved.

Elimination of special items

Railroad ties—Formerly the length of railroad ties purchased by this company was specified as 8 feet, 6 inches long. However, the manufacturers' standard length is 8 feet. By standardizing on the eight-foot length, quicker delivery and a better quality tie at less cost has been the result. This is an instance of making the company's requirements meet manufacturers' standards so that the required materials will not be classified as "special."

Steel—A small item made of steel of a certain specified chemical composition was being used frequently. The steel differed but little from that which was used regularly by the manufacturer. Investigation revealed that the steel regularly used was satisfactory for the service intended within this company. Since then the manufacturers' standard item has been used instead of the special analysis steel. This saves the necessity of a special run for the non-standard item. The saving can be summed up as several weeks in delivery time and nearly 50 per cent in cost.

Cross-arm brace—Formerly a heavy, special cross-arm brace was used in the overhead lines construction work. After an investigation by the Engineering Department the manufacturers' standard brace was adopted for our work with a resultant saving in shipping time and unit cost.

Substitution of one item for another

Stove bolts—In the case of stove bolts, several sizes were eliminated. Machine screws of equivalent sizes were recommended for use in their place.

Chain—As an example of an item new to this company replacing several others formerly used, the 4/0 twist link chain was chosen by the subcommittee to be used in place of a single jack, double jack, and three other types of chain.

Pole jacks—The factor of safety and the service of pole jacks was improved by raising the chain requirements from "BB" to "Dredge" quality.

Improvement in design

Bus bar benders—In the study of the bus bar benders, the subcommittee designed one which eliminated the known failings of the ones on the market at that time. The wealth of field experience available for this investigation enabled the members to design a bender of such merit that it is now a standard product with several manufacturers.

Tool bags—It has been the practice of this company to supply service repair men with canvas tool bags to carry their equipment to and from a job. The average life of these bags formerly was about six weeks. Failure almost invariably occurred from one of several causes. Either the handles pulled from the bag due to the excessive weight of the tools, or the bottom pulled out. The grip was the regular product of several different luggage manufacturers. The standardization subcommittee whose duty it was to study this type of material redesigned the bag with a view to eliminating its known weaknesses. The handles, which were formerly riveted to the top of the frame, were changed to straps which went entirely around the bag. They were riveted to the canvas sides and extended across the bottom. The design of the bottom in turn was changed to make it more rugged. Several different experimental designs were tried out. Some tool bags were made embodying several variations of this general design and given actual tests under service conditions. The bag as finally adopted for standard use costs less than five per cent more than the old kit. Definite figures on life are not available at this time in that the first standard bags were put in service about two and one-half years ago and are still apparently holding up satisfactorily.

A tool bag as redesigned by a standardization subcommittee. The life of this standard bag is more than 20 times the life of the tool bags formerly used

Terminal lugs—It was the practice to make one type of special terminal lug by drilling a piece of copper rod. Although the subcommittee could not substitute a manufacturers' standard lug for this item, a cost saving was

realized by fabricating the item from copper tubing instead.

Faulty nomenclature

Files—Inaccurate and ambiguous descriptions on purchase orders and requisitions cause an exceedingly great amount of annoyance and confusion. The latter in turn creates lost motion and wasted time in attempting to straighten out the tangle. A requisition which described a file as a "round hand mill file" is a case in point. "Round," "hand," and "mill" are each descriptive of a definite cross-sectional shape, all different. The desired article was possibly a round file for use by hand with the grade of cut most commonly found in mill files, which is the bastard cut. But consider the buyer's trouble in attempting to decipher such a requisition!

Control cord—The control cord on a lamp changer was formerly purchased direct from the manufacturer of the mechanism. The subcommittee assigned to this rope its correct description. When purchased according to the standards terminology an equivalent rope was obtainable at a saving of 40 per cent. In the latter case the cord was purchased from an authorized cordage dealer instead of letting the lamp changer manufacturer act as jobber.

Too little investigation

Bolts—An example of too much enthusiasm and too little investigation in standardization occurred in the course of considering bolts and nuts. For one particular job it was decided not to purchase the nuts, as they were not being used, and the subcommittee believed that the useless expenditure should be stopped. However, it was found later that the bolt cost more in this instance without the nut than with it. The explanation offered by the vendor was that the standard product terminated its passage through the production line with the nuts screwed on and the bolts boxed and packaged for shipment. To fill an order for the bolts alone it was necessary to have some one break open the boxes, unscrew the nuts, and repackage the bolts. An extra charge was added to cover labor costs.

Appendix

The classification of materials and supplies used by the Detroit Edison Company for its catalogs and records follows. For discussion of the classification see pages 49 to 54 in the February, 1932, issue of the ASA BULLETIN.

10. *Masonry and concrete material*
    - 10-0 Cinders, gravel, sand, crushed stone, etc.
    - 10-1 Lime, plaster, and cements
    - 10-2 Brick, terra cotta, vitrified sewer pipe, tile, etc.
    - 10-9 Miscellaneous masonry and concrete material
11. *Cut and artificial stone*
    - 11-0 Marble
    - 11-1 Slate
    - 11-2 Granite
    - 11-3 Alberene
    - 11-4 Artificial stone
    - 11-9 Miscellaneous stone
12.[1]
13. *Lumber*
    - 13-0 Yard lumber
    - 13-1 Millwork (doors, sash, interior trim, etc.)
    - 13-2 Timbers (ties, switch timers, etc.)
    - 13-9 Miscellaneous lumber (shavings, sawdust, etc.)
14. *Poles, cross arms, and other wooden line material*
    - 14-0 Poles
    - 14-1 Cross arms
    - 14-2 Other wooden line material
15. *Building insulation and lumber substitutes*
    - 15-0 Panel, plaster, and wall board
    - 15-1 Building and roofing papers
    - 15-2 Composition shingles, etc.
    - 15-9 Miscellaneous building insulation and lumber substitutes
16. *Paints and other protective coatings*
    - 16-0 Prepared paints
    - 16-1 Paint ingredients
    - 16-2 Bronzing material
    - 16-3 Driers
    - 16-4 Fillers
    - 16-5 Thinners
    - 16-6 Shellac and varnish
    - 16-7 Lacquer and enamel
    - 16-8 Other protective coatings
    - 16-9 Miscellaneous protective coatings
17.[1]
18. *Glass and glazing material*
    - 18-0 Clear sheet (window) glass
    - 18-1 Polished plate glass
    - 18-2 Obscure (rough) glass
    - 18-3 Wire glass
    - 18-4 Mirrors
    - 18-5 Glazing material
    - 18-9 Miscellaneous glass
19.[1]
20. *Builders' Hardware*
    - 20-0 Bars, plates, and rods
    - 20-1 Braces and brackets
    - 20-2 Hooks and holders
    - 20-3 Knobs, handles, and pulls
    - 20-4 Bolts, catches, and latches
    - 20-5 Locks and padlocks

[1] This class number is reserved for possible expansion of the classification as the need may arise in the future.

20-6 Door checks, springs, and stops
20-7 Hinges and door hangers
20-9 Miscellaneous builders' hardware

21.[1]

22 & 23. *General Hardware*
22-0 Abrasives
22-1 Carts, wagons, wheelbarrows, push trucks, etc.
22-2 Furniture shoes, casters, cart wheels, etc.
22-3 Containers (funnels, measures, buckets, barrels, cans, pots, kettles, etc.)
22-4 Fencing
22-5 Hose, hose fittings, and rubber tubing
22-6 Ladders, staging, scaffolds, etc.
22-7 Lanterns, flashlights, and torches
22-8 Lubricating equipment
23-0 Welding and soldering equipment
23-1 Pipe hangers and straps
23-2 Fittings for wire rope and chain
23-3 Springs
23-9 Miscellaneous general hardware

24. *Line hardware*
24-0 (Alphabetical arrangement)

25. *Bolts, screws, nails, rivets, etc.*
25-0 Anchors, shields, etc.
25-1 Bolts
25-2 Nuts
25-3 Cotters, washers, etc.
25-4 Brads, nails, spikes, etc.
25-5 Screws, screw eyes, and screw hooks
25-6 Rivets
25-9 Miscellaneous fasteners

26.[1]

27. *Tools (hand and machine)*
27-0 (Alphabetical arrangement)

28.[1]

29.[1]

30. *Iron and steel*
30-0 Rolled shapes and other hot rolled sections
30-1 Concrete reinforcing steel and supports
30-2 Iron and steel wire
30-3 Tool steel and special iron and steel
30-4 Fabricated structural steel
30-5 Fabricated structural steel for towers and outdoor substations
30-6 Fabricated ornamental work
30-7 Fabricated sheet steel
30-8 Fabricated plate work
30-9 Tanks and stacks

31.[1]

32. *Non-ferrous metals (aluminum, brass, etc.)*
32-0 Aluminum
32-1 Brass
32-2 Bronze
32-3 Copper
32-4 Lead
32-9 Miscellaneous metals (zinc, nickel, monel, etc.)

33. *Castings*
33-0 Aluminum castings
33-1 Brass castings
33-2 Bronze castings
33-3 Copper castings
33-4 Iron castings
33-5 Steel castings
33-9 Miscellaneous castings

34.[1]

35. *Building service equipment*
35-0 Building heating equipment
35-1 Refuse burners
35-2 Refrigerating equipment
35-3 Water coolers
35-9 Miscellaneous building service equipment

36. *Chain, rope, cord, etc.*
36-0 Chain
36-1 Wire rope (wire cable)
36-2 Fiber rope (manila, sisal, etc.)
36-3 Cord, twine, string, etc.
36-9 Miscellaneous chain and rope

37.[1]

38. *Hoisting machinery and equipment*
38-0 Platform elevators
38-1 Cranes
38-2 Hand hoists
38-3 Power hoists
38-4 Hoisting equipment
38-9 Miscellaneous hoisting machinery

39. *Mechanical power transmission equipment*
39-0 Belting and accessories
39-1 Pulleys
39-2 Bearings, bushings, boxes, hangers, etc.
39-3 Couplings, clutches, and collars
39-4 Drives, drive chains, and sprockets
39-5 Gears
39-9 Miscellaneous mechanical power transmission equipment

40.[1]

41. *Conveying and trenching machinery and equipment*
41-0 Gravity conveyors
41-1 Continuous conveyors
41-2 Jet and pneumatic conveyors
41-3 Miscellaneous conveyors
41-4 Conveyor equipment
41-5 Trenching machinery and equipment

42.[1]

43. *Stokers, burners, and coal preparation equipment*
43-0 Burners
43-1 Stokers

[1] This class number is reserved for possible expansion of the classification as the need may arise in the future.

43-2 Coal breakers, crushers, pulverizers, etc.

44. *Boilers, economizers, superheaters, and air preheaters*
- 44-0 Boilers
- 44-1 Economizers
- 44-2 Superheaters
- 44-3 Air preheaters

45. *Prime movers (including connected generators)*
- 45-0 Turbo-generator units
- 45-1 Turbines
- 45-2 Steam engines
- 45-3 Internal combustion engines
- 45-4 Water wheels

46. *Condensers, evaporators, heaters, and water purifiers*
- 46-0 Condensers
- 46-1 Evaporators
- 46-2 Water heaters
- 46-3 Water purifiers

47. *Pumps and compressors*
- 47-0 Pumps
- 47-1 Air and gas compressors

48.[1]

49. *Air and flue gas cleaning and handling apparatus*
- 49-0 Air filters and supplies
- 49-1 Air washers, coolers, and humidifiers
- 49-2 Fans
- 49-3 Air heaters
- 49-4 Dust collectors, precipitators, etc.
- 49-9 Miscellaneous air and flue gas apparatus

50. *Oil separators, reclaimers, coolers, etc.*
- 50-0 Oil separators
- 50-1 Oil reclaimers and purifiers
- 50-2 Oil filters
- 50-3 Oil coolers
- 50-4 Oil apparatus accessories
- 50-9 Miscellaneous oil apparatus

51. *Pipe and tubing (including soil pipe)*
- 51-0 Steel pipe and tubing
- 51-1 Wrought iron pipe
- 51-2 Cast iron pipe
- 51-3 Copper pipe and tubing
- 51-4 Brass pipe and tubing
- 51-5 Lead pipe
- 51-6 Aluminum pipe and tubing
- 51-9 Miscellaneous pipe

52. *Pipe fittings*
- 52-0 Pressure fittings
- 52-1 Drainage fittings
- 52-2 Soil pipe fittings
- 52-3 Railing fittings
- 52-4 Pipe frame fittings

53.[1]

54. *Valves*
- 54-0 Angle valves
- 54-1 Check, non-return, and stop-check valves
- 54-2 Gate valves
- 54-3 Globe valves
- 54-4 Safety relief valves
- 54-5 Float, foot, and regulator valves
- 54-6 Cocks (plug valves)
- 54-9 Miscellaneous valves

55. *Piping specialties and plumbing fixtures*
- 55-0 (Alphabetical arrangement)

56. *Packing and gaskets*
- 56-0 Rod, shaft, and valve stem packing
- 56-1 Sheet packing
- 56-2 Gaskets
- 56-9 Miscellaneous packing

57.[1]

58. *Heat insulation*
- 58-0 Asbestos
- 58-1 Cork
- 58-2 Hair and wool
- 58-3 Magnesia
- 58-4 Insulating cements
- 58-9 Miscellaneous heat insulation

59. *Refractories (fire brick, fire clay, etc.)*
- 59-0 Fire brick
- 59-1 Fire clay
- 59-2 Refractory cements
- 59-9 Miscellaneous refractories

60. *Mechanical control apparatus*
- 60-0 Temperature controls
- 60-1 Pressure controls
- 60-2 Volume controls
- 60-3 Speed controls
- 60-9 Miscellaneous mechanical control apparatus

61. *Mechanical measuring instruments*
- 61-0 Temperature measuring instruments
- 61-1 Pressure measuring instruments
- 61-2 Weight and volume measuring instruments
- 61-3 Time measuring instruments
- 61-4 Velocity measuring instruments
- 61-5 Dimensional measuring instruments
- 61-6 Chemical composition measuring instruments
- 61-9 Miscellaneous mechanical measuring instruments

62.[1]

63. *Electrical measuring instruments (except electricity meters)*
- 63-0 Ammeters
- 63-1 Voltmeters
- 63-2 Wattmeters
- 63-3 Reactive volt-ampere meters
- 63-4 Frequency meters
- 63-5 Power factor, reactive factor, and phase angle meters

[1] This class number is reserved for possible expansion of the classification as the need may arise in the future.

63-9 Miscellaneous electrical measuring instruments

64. *Electricity meters*
 64-0 Watthour meters
 64-1 Demand meters

65. *Motors, generators, and controls*
 65-0 Motors
 65-1 Generators
 65-2 Motor-generator sets, rotary converters, etc.
 65-3 Carbon brushes
 65-4 Control equipment

66. *Transformers, regulators, and reactors*
 66-0 Power transformers
 66-1 Distribution transformers
 66-2 Street lighting transformers
 66-3 Instrument transformers
 66-4 Induction voltage regulators
 66-5 Reactors
 66-6 Capacitors (static condensers)
 66-9 Miscellaneous transformers and regulators

67.[1]

68. *Circuit breakers, switches, relays, and jumpers*
 68-0 Oil circuit breakers
 68-1 Air circuit breakers (carbon break)
 68-2 Knife type switches
 68-3 Safety switches
 68-4 Control switches
 68-5 Household switches
 68-6 Relays
 68-7 Jumpers, plugs, and jumper plug receptacles
 68-9 Miscellaneous switches

69.[1]

70. *Fuses*
 70-0 125-volt fuses
 70-1 250-volt fuses
 70-2 600-volt fuses
 70-3 4800-volt fuses
 70-4 24,000-volt fuses
 70-5 Fuse parts
 70-6 Holders for fuses 4800 volts and higher
 70-9 Miscellaneous fuses

71 & 72. *Wire and cable conductors*
 71-0 Bare wire
 71-1 Magnet and resistance wire
 71-2 Weather-proof wire
 71-3 Rubber covered and other insulated wire
 71-4 Telephone cable
 71-5 600-volt cable
 71-6 4800-volt cable
 71-7 7500-volt cable (street lighting cable)
 71-8 13,200-volt cable
 72-0 24,000-volt cable

[1] This class number is reserved for possible expansion of the classification as the need may arise in the future.

 72-1 Conductor connectors and terminals (lugs)
 72-9 Miscellaneous conductors

73. *Underground conduit and fittings*
 73-0 Fiber conduit and fittings
 73-1 Clay conduit and fittings
 73-9 Miscellaneous underground conduit and fittings

74. *Wiring supplies*
 74-0 Metallic conduit and fittings
 74-1 Steel boxes, cabinets, and panels
 74-2 Receptacles, plugs, and sockets
 74-3 Lighting fixtures and accessories
 74-5 Cutout bases (fuse blocks)
 74-6 Special switchboard equipment and supplies
 74-9 Miscellaneous wiring supplies

75.[1]

76. *Electric insulation and insulators*
 76-0 Insulation
 76-1 Insulators
 76-2 Insulator hardware

77. *Lightning arresters*
 77-0 (Arranged by voltage)

78. *Potheads*
 78-0 Disconnecting potheads
 78-1 Non-disconnecting potheads

79. *Street lighting equipment*
 79-0 Overhead street lighting equipment
 79-1 Underground street lighting equipment
 79-9 Miscellaneous street lighting material

80. *Lamps*
 80-0 Miniature lamps (16 volt and under)
 80-1 28- to 32-volt lamps
 80-2 120-volt lamps
 80-3 Series lamps (street lighting)
 80-9 Miscellaneous lamps

81.[1]

82. *Communication and signaling equipment and supplies*
 82-0 Telephone equipment and supplies
 82-1 Radio equipment and supplies
 82-2 Signs, painted and electric
 82-3 Bells, buzzers, horns, whistles, annunciators, semaphores, etc.
 82-9 Miscellaneous communication and signaling equipment and supplies

83. *Batteries and battery equipment and supplies*
 83-0 Storage batteries
 83-1 Dry batteries
 83-2 Battery chargers, equipment, and supplies

84. *Appliances*
 84-0 Electric appliances (including accessories)
 84-1 Parts for electric appliances

84-2 Gas appliances (including accessories)
84-3 Parts for gas appliances

85. *Special gas plant equipment, material, and supplies*
85-0 (Alphabetical arrangement)

86. *Special railroad equipment, material, and supplies*
86-0 Locomotives
86-1 Railroad cars
86-2 Track material

87. *Motor vehicles and equipment*
87-0 Passenger automobiles
87-1 Trucks, trailers, and diggers
87-2 Tractors
87-3 Motor vehicle accessories
87-9 Miscellaneous motor vehicles and equipment

88. *Fuel (except oil)*
88-0 Coal
88-1 Coke
88-9 Miscellaneous fuel

89 & 90. *Petroleum and coal distillation products*
89-0 Fuel oil
89-1 Gas enriching oil
89-2 Lubricating oil
89-3 Gasoline
89-4 Insulating oils and compounds
89-5 Greases
89-6 Paraffin and waxes
89-7 Tar, asphalt, etc.
90-9 Miscellaneous petroleum and coal distillation products

91.[1]

92. *Chemicals, drugs, and compounds*
92-0 Chemicals
92-1 Medicinal compounds and formulas
92-2 Cleaners and polishes
92-3 Disinfectants and exterminators
92-9 Miscellaneous compounds

93. *Textiles*
93-0 Fabricated textiles
93-1 Unfabricated textiles

94. *Medical equipment and supplies*
94-0 Medical equipment
94-1 Gauze and bandages
94-9 Miscellaneous medical supplies

95. *Janitors' equipment and supplies*
95-0 (Alphabetical arrangement)

96. *Office equipment and stationery supplies*
96-0 Furniture, lockers, and shelving
96-1 Machines and accessories
96-2 Paper
96-3 Printed forms
96-4 Books, magazines, etc.
96-5 Other stationery supplies

97. *Restaurant equipment and supplies*
97-0 Restaurant equipment
97-1 Food
97-2 Sundries

98 & 99. *Items not otherwise classified*
98-0 Explosives and firearms
98-1 Safety equipment
98-2 Fire fighting equipment
98-3 Household furniture and furnishings
98-4 Nursery supplies
98-5 Special laboratory equipment
98-6 Special construction equipment and materials
98-7 Plating
98-9 Miscellaneous
99-0 Rubber goods
99-1 Leather goods
99-9 Material returnable to vendor (reels, drums, lagging, etc.)

[1] This class number is reserved for possible expansion of the classification as the need may arise in the future.

F.S.B. Standards Available from ASA

The following standards have recently been published by the Federal Specifications Board. Copies may be purchased at five cents each or borrowed through the ASA office:

Cleaning materials	
Soda, caustic (lye): cleaning purposes	P-S-631
Soda; laundry	P-S-641
Solvent; dry-cleaning	P-S-661
Trisodium phosphate; technical	O-T-671
Hospital supplies	
Aprons; rubber, surgeons'	ZZ-A-611
Bandages; rubber	ZZ-B-101
Bottles; hot-water, cloth-inserted	ZZ-B-581
Bottles; hot-water, rubber	ZZ-B-586
Cushions; ring, cloth-inserted	ZZ-C-791
Ice-bags; helmet-shaped	ZZ-I-111
Ice-bags; rubber	ZZ-I-121
Sheeting; rubber	ZZ-S-311
Paint	
Bone-black; dry, paste-in-Japan, paste-in-oil	TT-B-601
Chrome, green; pure, dry, paste-in-Japan, paste-in-oil	TT-C-236
Enamel; pigmented, black	TT-E-521
Lampblack; dry, paste-in-Japan, paste-in-oil	TT-L-71
Ultramarine-blue; dry, paste-in-Japan, paste-in-oil	TT-U-451
Textiles, thread and twine	
Cloth; awning	CCC-C-406
Denim; blue, indigo	CCC-D-151
Linen; table	DDD-L-391
Sheeting; cotton, unbleached, narrow	CCC-S-281
Thread; linen	V-T-291
Thread; silk	V-T-301
Twine; jute	T-T-911
Miscellaneous	
Acetone	O-A-51
Calcium-carbide	O-C-101
Concrete-units; masonry, hollow	SS-C-621
Fire extinguishers; chemical, hand (soda-and-acid type)	O-F-355
Glycerin	O-G-491
Sodium-sulphite; anhydrous (photography)	O-S-606
Wood-preservative; preservative treatment	TT-W-571

Horizontal Forces Produced by Movements of the Occupants of a Grandstand

A report on tests conducted by the Department of Labor and Industry of Pennsylvania at the plant of the Wayne Iron Works

Owing to the lack of reliable data concerning the horizontal forces set up in a grandstand by the movements of the occupants, the Department of Labor and Industry of the Commonwealth of Pennsylvania undertook to make a test to determine the maximum extent of these forces. To this end, the American Standards Association[1] and the Wayne Iron Works were asked to cooperate.

The apparatus was designed and manufactured by the Wayne Iron Works and the test took place in their shop at Wayne, Pennsylvania, on November 24, 1931, employees of the Wayne Iron Works occupying and operating the testing apparatus.

The following were present on invitation of the Department of Labor and Industry or of the American Standards Association: S. W. Homan, assistant director, Bureau of Industrial Standards, Pennsylvania Department of Labor and Industry; A. J. Boase, regional structural engineer, Portland Cement Association; C. J. Raider, National Bureau of Casualty & Surety Underwriters; Holger Jensen, manager, Engineering and Rating Bureau, Maryland Casualty Company; H. W. Matthews, supervisor of inspections, Aetna Casualty & Surety Company; George B. Smith, Jr., representing the National Association of Amusement Parks; C. H. Wetzel, Wayne Iron Works.

These men directed the test, checked the observations, made the resulting computations, and concur in the conclusions.

B. F. Hastings, district engineer, American Institute of Steel Construction, although unable to attend the test, called at the Wayne Iron Works the following day, inspected the apparatus, checked the computations, and concurs in the conclusions.

While the conclusions contained in this report are those of the committee making the tests, the committee realizes that the conclusions are not necessarily correct and, therefore, invites those reading the report to send to the American Standards Association their comments.

The apparatus was similar in principle to the old-fashioned lawn swing. It consisted of a steel platform six feet square made up to three-inch channels framed together and adequately cross-braced. The platform was suspended from the ceiling beams by means of four hangers of two-inch angle. Each hanger was attached to the side of a ceiling beam by means of a single lag screw, and to the side of the platform by means of a single bolt. These screws and bolts served as bearings. The hangers were braced together in pairs. Therefore, the platform was free to swing in one plane but not in the other, the platform remaining level while swinging. Adjacent to one end of the platform, a bracket was fastened to the floor. This bracket carried a heavy screw whose head projected from the bracket toward the end of the platform. The platform could be swung away from the screw, but on the return swing would bump against the head of the screw and stop swinging. By turning the screw, the head would bear against the end of the platform and force the hangers out of plumb, reducing the amplitude of the swing.

Upon the platform was erected a standard three-row portable steel grandstand four feet long, taken from the stock of the Wayne Iron Works. When testing lateral forces, the stand was erected with one end toward the screw as shown in Figure 1. When testing forces in a front-to-back direction it was set up facing the screw. In both positions it was clamped to the platform to prevent sliding. Weights consisting of three-inch square bars were also clamped to the platform to reduce the amplitude of the swing.

Method of making the test

The stand was occupied by men who were urged to exert their full strength in unison to produce the maximum possible horizontal force in a direction away from the screw. As they would sway, the platform would swing away from the screw and return to bump against it. The screw was then turned, reducing the amplitude of the swing, until the point of equilibrium was reached where it was just barely possible for the men to move the platform. The displacement of the hangers from a vertical position was then measured. From this

[1] A Safety Code for Grandstands (Z20) is in progress of development under the procedure of the American Standards Association.

displacement and the weights involved, the horizontal force was calculated.

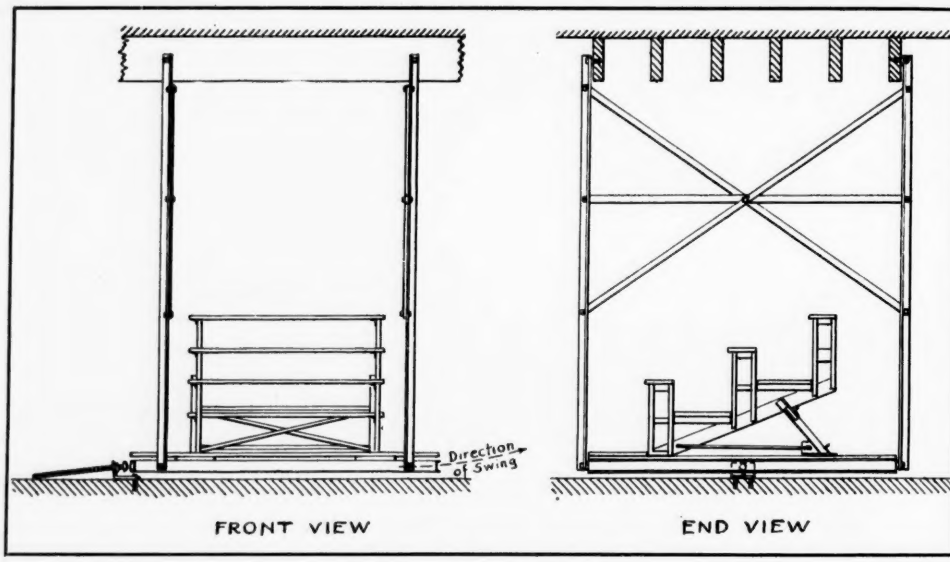


Fig. 1
Drawing showing the construction of the test grandstand

Method of computing horizontal forces

The direction of hangers when at the point of equilibrium is the resultant of two components—the weight of the men and apparatus, acting vertically; and the sway force, acting horizontally. Referring to Figure 2 where d represents the horizontal displacement, h the vertical distance between bearings, r the radial distance along the hangers between bearings, W the total effective weight, and S the horizontal swaying force,

$$S : W : : d : h$$

$$d^2 + h^2 = r^2$$

$$\text{Therefore } S = \frac{Wd}{h} \text{ or } \frac{Wd}{\sqrt{r^2 - d^2}}$$

Forces determined

Tests were made to determine the horizontal forces produced by the following:

1. Lateral sway—men seated and gripping the front edge of the seat boards with their hands
2. Lateral sway—men seated but not using their hands
3. Lateral sway—men standing
4. Front to back sway—men seated and suddenly rising
5. Front to back sway—men standing and suddenly sitting

The five tests were made with nine men on the stand. The first four were then repeated with three men on the stand. (The fifth was not made with three men, as its result with nine men was almost identical with the fourth, and it was considered of little importance because spectators seldom if ever sit down in unison.)

Each test was repeated several times in order to secure the maximum unison in the movements of the men and therefore the maximum possible force.

Observations made on tests

Observations were made as follows:

Radial distance along the hangers between bearings (r) 9 ft, 0 in.

Effective weight of hangers; *i.e.*, the portion of their weight reacting on the bearings of the platform	116 lb	
Weight of platform	270	
Weight of grandstand	301	
Weight of 3 in. square bars	274	
Total effective weight of apparatus		961 lb
Weight of 9 men	1289 lb	
Total effective weight (W) with 9 men		2250 lb
Weight of 3 men	420 lb	
Total effective weight (W) with 3 men		1381 lb

Horizontal displacement:

	With 9 men	*With 3 men*
First test	$22^{3}/_{8}$ in.	$22^{11}/_{16}$ in.
Second test	$22^{1}/_{8}$	$16^{1}/_{2}$
Third test	$16^{3}/_{4}$	$10^{7}/_{16}$
Fourth test	$8^{3}/_{8}$	$5^{7}/_{16}$
Fifth test	$8^{9}/_{16}$	

Linear feet of seats occupied	
by 9 men	12 ft
by 3 men	4 ft
Square feet of stand occupied	
by 9 men	22 sq ft
by 3 men	$7^{1}/_{3}$ sq ft

Computations and results

As an example of the computations, take the first test with nine men

$$d = 22^{3}/_{8} \text{ in.}$$

$$r = 108 \text{ in.}$$

$$W = 2250 \text{ lb}$$

$$h = \sqrt{r^2 - d^2} = 105^{21}/_{32} \text{ in.}$$

$$S = \frac{Wd}{h} = \frac{2250 \times 22^{3}/_{8}}{105^{21}/_{32}} = 477 \text{ lb}$$

Other forces were computed in the same manner.

The results are shown in Table I.

3. Momentum due to movement of the stand
4. Inertia of the apparatus
5. Friction

Of these, friction is negligible. The platform

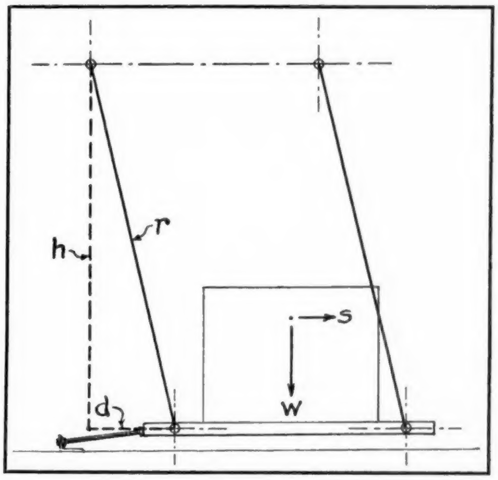


FIG. 2

Representation of forces acting on grandstand

could be easily swung by a light pressure of one finger.

The effect of inertia of the apparatus is negligible. At the position where observations

	Total force	*Force per man*	*Force per linear ft of seats*	*Force per sq ft of stand*	*Percentage of weight of men*
Side sway	*pounds*				
(1). 9 men sitting and holding	477	53	40	22	37
(1). 3 men sitting and holding	297	99	74	40	71
(2). 9 men sitting not holding	471	52	39	21	37
(2). 3 men sitting not holding	213	71	53	29	51
(3). 9 men standing	353	39	29	16	27
(3). 3 men standing	134	45	34	18	32
Front-to-back sway					
(4). 9 men suddenly rising	175	19	15	8	14
(4). 3 men suddenly rising	70	23	17	9	17
(5). 9 men suddenly sitting	179	20	15	8	14

TABLE I

Horizontal sway force

The results may be in error by reason of any of the following:

1. Lack of unison in the movements of the men
2. Variation in effort exerted by the men

were recorded, the movement of the platform was barely perceptible and therefore the force required to produce such movement would be extremely small.

The effect of momentum due to movement of the stand is not negligible. The stand, being

portable, had small clearances between parts. These clearances and the deflection of members of the stand allowed the stand itself to sway perceptibly. This movement added to the momentum of the men's bodies. Therefore, the calculated forces are somewhat higher than would have been produced had the stand been rigid. The purpose of the test was to determine the sway forces produced on an actual grandstand, rather than the forces that might have been produced on a rigid structure. Therefore, no effort was made to restrict the movement of the stand, and any error is on the side of safety. The movement of the stand was apparently greater with three men than with nine.

The effect of variation in the effort exerted by the men was eliminated as far as possible by repeating the tests several times and urging the men to exert themselves. Only the maximum force was measured in each case, so that the effect of possible variation is probably quite small.

The effect of lack of unison in the movements of the men is undoubtedly the largest possible source of error. Every effort was made to get the men to act together in rhythm. Their movement was probably more uniform than would be likely to occur among any group of spectators on a large grandstand.

Considerably more unison was attained by three men than by nine.

Conclusion

The results of the side-sway tests show that more lateral force is developed in a sitting position than when standing. Therefore, the result of the third test can be eliminated from consideration.

The result of the second test, the men sitting but not using their hands, indicates that the maximum side sway per man produced by nine men is about 75 per cent of that produced by three men. It therefore seems reasonable to suppose that a large crowd could produce a maximum side sway per man of about 75 per cent of that produced by nine men provided they use their full strength, which is very unlikely. It seems reasonable to assume that a large crowd will never exert more than 80 per cent of their full strength. Therefore, the probable maximum side sway of a large crowd is not likely to exceed 80 per cent of 75 per cent, or 60 per cent of that produced by nine men. The maximum side sway produced by nine men was 40 pounds per linear foot of seats or 22 pounds per square foot of stand. Sixty per cent of these is 24 pounds per linear foot of seats or 13 pounds per square foot of stand.

As a check up, suppose a steel stand is designed for a side sway of 24 pounds per linear foot of seats with a fiber stress of 18,000 pounds per square inch.

Suppose the above assumed percentages are incorrect and the spectators could develop the same force as was produced by nine men, *i.e.*, 40 pounds per linear foot of seats. The actual fiber stress would be $\frac{40}{24} \times 18{,}000$ or 30,000 pounds per square inch. Therefore, the stand would be stressed to, but not beyond, the elastic limit of the material.

Now suppose the spectators could develop the same force as was produced by three men, *i.e.*, 74 pounds per linear foot of seats. The actual fiber stress would then be $\frac{74}{24} \times 18{,}000$ or 55,500 pounds per square inch. Therefore, the stand would be badly strained but not ruptured. As the first of these suppositions is highly improbable and the second is practically impossible, an assumed side sway of 24 pounds per linear foot of seats seems perfectly safe.

The results of the front-to-back sway test show that suddenly sitting produces practically the same force as suddenly rising. A large crowd is not likely to sit down in unison and therefore the result of the fifth test can be eliminated from consideration. Making the same assumptions for sudden rising as were made above for side sway would indicate that the probable front-to-back force produced by a large crowd will not exceed 60 per cent of that produced by nine men. This gives a figure for design purposes of 9 pounds per linear foot of seats or 5 pounds per square foot of stands.

It is, therefore, recommended that the following assumed horizontal forces shall be used in designing grandstands:

24 pounds per linear foot of seats, or
13 pounds per square foot of stand, applied to each bent at the average level of the seats supported by that bent, in a direction parallel to the rows of seats.

9 pounds per linear foot of seats, or
5 pounds per square foot of stand, applied to each bent at the average level of the seats supported by that bent, in a direction at right angles to the rows of seats.

Index of British Standards

Copies of an *Indexed List of British Standard Specifications*, dated January 1, 1932, have just been received at the ASA office and may be purchased for 25 cents each. The list includes about 500 standards in almost every industrial and engineering field, which have received the approval of the British Standards Institution.

Some Problems of Hole Tolerances Affecting Tool Manufacture[1]

by

John Gaillard, *Mechanical Engineer*
American Standards Association

The relation between hole tolerances and reamer sizes; a review of the standards adopted by German manufacturers

In establishing a standard system of fits between cylindrical parts, should hole tolerances be chosen primarily to secure the greatest clarity and facility for the machine designer combined with the maximum degree of interchangeability between internal and external parts? Or should the choice of hole tolerances be based mainly on considerations of the tool problem, such as the possibility of using one size of new reamer for all holes whatever their tolerances may be? If the former question is to be answered in the affirmative, this would mean that the hole tolerances should be plus tolerances on the nominal hole sizes, but if the latter question is thus to be answered, the hole tolerances must be taken downward from a common reference line.

The above questions have come up as the result of criticism raised against the American Standard on fits (American Tentative Standard on Tolerances, Allowances, and Gages for Metal Fits—B4a-1925—now under revision). A special aspect of the problem was given considerable attention during the past year in *American Machinist* when a system of hole tolerances extending downward from a line located 0.0005 in. above the nominal size of the holes was described and discussed.

In its general aspect, the problem involves the criticism that has been raised against the American Standard on the ground that the standard holes cannot be finished economically with the present sizes of commercial stock reamers. To take a concrete example, a 1-in. American Standard hole has a low limit of 1.0000 in., and a high limit of 1.0030, 1.0013, 1.0008, or 1.0006 in., depending on the "class" of the hole. The reamers listed in the catalogs of the tool manufacturers are held within a small plus tolerance on their nominal size. Thus, one of the prominent firms supplies its 1-in. reamers between the limits 1.0000 and 1.0003 in. Such reamers soon wear down to the point where they begin to produce holes whose size lies below the nominal, which holes are not acceptable according to the American Standard. Therefore, even though reamers worn down to this extent may still be in good condition for further use, they must be retired from production. Such loss of useful reamer life raises the cost of producing standard holes unduly, those objecting to the American Standard say. This attitude has apparently been one of the reasons why the present American Standard has not become more widely introduced into practice.

An analysis of the problem shows that the essential questions involved appear to be those mentioned in the beginning of this article, or put in a simpler form: Shall the hole tolerances control, or be controlled by, the tool situation? The fact that this question still looms up, even though it has been answered in 12 countries, including the United States, to the effect that the system of hole tolerances is the most important factor, seems to justify further discussion, especially so as it has been solved in practice in at least one important industrial country where national standard fits have been generally adopted; that is, Germany. We shall come back to this later in this article.

Problem of bilateral tolerances

The present situation in the United States seems to exist because two parts of the same problem have gotten out of step instead of remaining coordinates. The older practice of giving a tolerance on a part consisted in permitting an equal plus and minus variation from its nominal size. Instead of being unilateral as required by the present American Standard, the tolerance was a bilateral one.[2] The high

[1] Reprinted from *American Machinist*, October 8, 1931.

[2] Bilateral tolerances may occasionally be used with advantage where a given size is aimed at to be approximated as closely as possible in an absolute manner, such as the nominal size of certain kinds of limit gages or a distance between the center of holes. However, unilateral tolerances have been found to be preferable for a general system of fits between cylindrical parts laid down in a national standard.

limit of a hole with such a bilateral tolerance is located more closely to the nominal or basic size than the high limit of a hole with a unilateral plus tolerance of the same numerical value. Furthermore, the minus portion of a bilateral tolerance makes undersize holes lying within a certain range acceptable and permits the present commercial reamers to wear down further, and therefore to be used longer, than does a unilateral plus tolerance of equal value. The manufacturing limits of the present commercial stock reamers are still adjusted to the old condition instead of to the modern standard holes with unilateral plus tolerances. This means that in principle the harmony between hole tolerances and reamer sizes has been disrupted. In fact, to be produced economically the present American Standard holes should be finished, generally speaking, with reamers whose sizes are held between limits lying farther above the nominal size of the hole than the limits of the present commercial reamers. A 1-in. reamer intended for finishing a 1-in. class 2, American Standard hole (limits 1.0000 and 1.0013 in.) should not be held between 1.0000 and 1.0003 in. as are the commercial reamers mentioned above as an example, but, say, between the limits 1.0005 and 1.0008 in. Evidently, the high limit of the reamer should be held a certain distance below the high limit of the hole with a view to the possibility of the reamer's cutting oversize.

Difficulties in changing

When the question is raised of changing the sizes of stock reamers to adapt them to the requirements of American Standard holes in the way referred to above, objection may be expected on account of the usual difficulties inherent in making a change from existing practice. Such difficulties, however, are bound to occur in a certain degree during any period of changing over from an old to a new standard. Another objection, which has been raised in giving consideration to this problem, is that the tool manufacturer instead of having to keep one reamer in stock for each nominal size would have to carry a reamer for each standard hole tolerance; that is, four different reamers for each nominal size of hole. The nominal sizes of certain types of commonly used stock reamers as now listed in tool catalogs step up by increments in diameter as small as $^1/_{32}$ in. The prospect of having to multiply the number of stock reamers by four must indeed appear like a nightmare to the tool manufacturer and practically form a bar to the solution mentioned. Fortunately, things are not always so dark as they appear at first sight, and further consideration of the present case will show how and why the situation could practically develop in the right direction without any considerable difficulty, and more specifically without requiring the prohibitive variety of reamer sizes feared by some.

It is the writer's earnest belief that if American Standard holes became generally adopted, and if therefore the reamers most suitable to produce them came into greater demand, these tools would automatically become a stock product readily available without extra charge. Such a result could, of course, be attained only by the combined demand of a large number of users for the new kind of reamers, based on their decision to use the American Standard fits and the holes required for these. This belief is not based on a mere theory, as it has been shown that similar conditions have worked out in actual practice. If doubt arises whether the general adoption of the standard fits by industry would indeed have this effect on the tool situation, attention may be called to the production of standard fits between threaded parts and the relationship between these fits and the taps for producing the internal threads. Since standard limits for threads on bolts and nuts were established in 1924 (American Standard B1a-1924 on Screw Threads for Bolts, Nuts, and Commercially Tapped Holes) to secure specific classes of fits between the two groups of parts, several tool manufacturers have been supplying as stock tools four different taps for each nominal size of thread. The taps have a tolerance of 0.0005 in. on the pitch diameter and the tolerance on each kind of tap has a different position relative to the basic profile of the thread. The pitch tolerances on the four taps are, respectively: minus 0.0005 in. to basic; basic to plus 0.0005 in.; plus 0.0005 to plus 0.0010 in.; and plus 0.0010 to plus 0.0013 in. This enables the user of taps to select from the series of four that particular tap which is most suitable to the fit required in his case under the existing conditions as to material to be tapped, speed of tapping, lubrication, and other factors. Ten years ago the idea of establishing, for the same kind of thread, four different taps whose individual tolerances on pitch diameter all lie within so small a total range as 0.002 in. would probably have been decried by many as too refined and too complicated a scheme to be practicable. Yet the system has materialized as a result of the fact that the American Standard screw threads and their fits have become widely adopted in practice.

Another example, proving that the practical adaptation of tools to the requirements of the standardized product is brought about automatically, provided the standard for the product be generally adopted, is the relationship between cylindrical fits and reamers in Germany. In that country, a national standard on fits established in 1920 has been generally adopted by the

national industry. In 1930, its adoption was close to 100 per cent, to judge among other

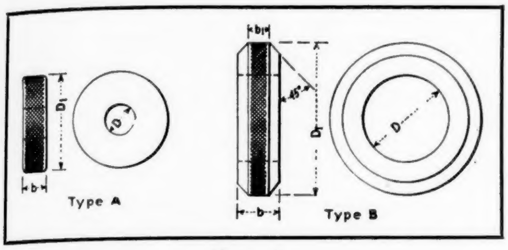


FIG. 1

German Standard gages for reamers below 100 mm (type A) and between 100 and 150 mm (type B), respectively

things from the orders on limit gages received by gage manufacturers. In fact, orders on non-standard gages have become exceptional. Another proof of the remarkable success of German standard fits in practice is its adoption by more than 1000 German industrial organizations, manufacturing mechanical products covering a wide range, from precision machine tools and limit gages to agricultural machinery; from automobiles and trucks to cash registers; and from electric motors to Diesel engines. Firms like the German General Electric Company (AEG) and Siemens Schuckert Works, in the electrical field; the Maybach Motor Company, and the Daimler-Benz Works in the automotive field; and the Friedrich Krupp Company manufacturing a large variety of products, have stated they are using the standard successfully, to mention only a few important ones.

The German standard comprises both the basic hole and the basic shaft system. A large German manufacturer of tools and gages stated to the writer in 1930 that 80 per cent of the gages ordered from his firm are intended to serve fits in the basic hole system. As this system is in principle similar to that laid down in the American Standard, even in that it makes provision like the latter for four different plus tolerances on the basic hole of a given nominal size, the following facts concerning the relationship between hole tolerances and tools in German practice are of interest.

With a view to producing correctly their standard basic holes, the Germans have established a national standard (DIN 369) on gage rings for reamers. These are rings intended for setting an expansion reamer to the correct size required for finishing the hole. Two types of such rings have been standardized in Germany as shown in Figure 1. Type A is intended for reamers with a diameter up to 100 mm (about 4 in.), inclusive, and Type B for reamers from 100 to 150 mm (from about 4 to 6 in.). The standard gives, among other dimensions, the nominal diameter D of the bore of each ring and the tolerance on that diameter. The numerical value of D is based on the formula (not given in the standard):

$$D = d + 2/3\,h$$

in which d is the basic size of the hole to be finished by the reamer, and h the tolerance on that hole. In other words, the size of an expansion reamer set with a standard gage ring will be smaller than the maximum size of the hole to be finished with that reamer by an amount which is equal to at least one-third of the tolerance on the hole. This provision takes care of the requirement that even though the reamer may cut oversize, trespassing of the high limit of the hole should be avoided.

To illustrate the German system, Figure 2 shows on the left hand side the tolerance A on a German "fine grade" hole with a nominal size of one in., this tolerance being 0.0009 in. In accordance with the above formula, the nominal size of the bore of the corresponding gage ring for the expansion reamer is 1.0006 in. A manufacturing tolerance on the bore of the gage ring being required, such tolerance is given in the minus direction from the nominal size. The tolerance P on the bore of the gage ring under consideration is 0.00012 in., the limits of the bore being consequently 1.00048 and 1.0006 in.

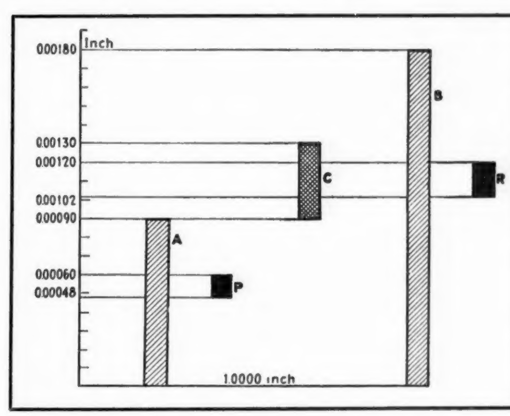


FIG. 2

The German tolerances on basic holes, reamer sizes, and gage ring bores

A—tolerance on a "fine grade" hole
B—tolerance on a "medium grade" hole
C—tolerance on a reamer before final sizing
P—tolerance on the bore of a ring for gaging a reamer for a "fine grade" hole
R—tolerance on the bore of a ring for gaging a reamer for a "medium grade" hole

A 1-in. German standard hole of the "medium grade," whose tolerance B is 0.0018 in., is shown on the right hand side in Figure 2. The

bore of the gage ring for setting a reamer to finish this grade of hole has a nominal diameter of 1.0012 in. with a minus tolerance *R* of 0.00018 in., the limits of the bore of this gage ring consequently being 1.00102 and 1.0012 in.

No German national standard has as yet been adopted for the manufacturing limits of solid reamers. According to the list of the German tool and gage manufacturer referred to above, solid reamers are supplied with the same sizes as those prescribed for expansion reamers by their gage rings. Particularly interesting is the fact that in 1929 the German Association of Precision Tool Manufacturers published an agreement made between its members concerning the supply of solid reamers. Stock reamers are held between such manufacturing limits as will permit their being ground, when ordered, to the size suitable for finishing a hole with a specific standard tolerance. An extra charge for this adjustment in size is made only for orders on less than six reamers. Consequently, for an order of any importance, the reamers intended for holes to give standard fits are supplied at the catalog prices.

Figure 2 shows how the tool manufacturers' agreement works out for stock reamers for holes with a nominal size of 1 in. The reamers are manufactured without advance knowledge of the tolerances on the holes for which they are to be used. They may have to be adjusted to the requirements of a "fine grade" hole or of a "medium grade" hole whose tolerances are represented in Figure 2. This figure illustrates the case of an important German firm which holds its stock reamers, before their final sizing, between the limits 1.0009 and 1.0013 in. (tolerance *C*). When reamers for "fine grade" holes are ordered, these stock reamers must be ground down to such extent that they will pass the corresponding standard gage ring, the limits of whose bore are 1.0006 and 1.00048 in. If the stock reamers are to be used for standard "medium grade" holes, they must pass the standard gage ring with a bore whose limits are 1.0012 and 1.00102 in. The diagram on the right hand side of Figure 2 shows that in this case, reamers whose original size lies within the lower part of tolerance *C* are suitable without any further adjustment, while reamers whose size lies closer to their high limit must be ground to a slightly smaller diameter.

Incidentally, stock reamers are made only for holes with nominal sizes belonging to the German standard series of diameters (DIN 3). For example, within the range upward from 50 to 75 mm (about 2 to 3 in.), inclusive, only the following diameters are standard: 52, 55, 58, 60, 62, 65, 80, 70, 72, and 75 mm, or ten sizes.

From the above, it will be seen that German tool manufacturers have adjusted the manufacture of their reamers on their own initiative to the requirements of the national standard fits. A German engineer who had a large share in the development of the national standard on fits in his country has declared that the Germans, when setting up their standard system of fits, paid no attention whatever to the reamer sizes, considering this as a factor that would take care of itself once the standard fits, and therefore standard hole tolerances, would have become generally adopted. As explained above, matters actually have developed in this way. The German situation also shows that the adjustment of stock reamers to national standard hole tolerances does not necessarily lead to considerable variety in reamer sizes in manufacture and stock-keeping. One set of limits is observed in manufacturing the stock reamers, these limits lying well above the basic size of the hole. In this way, the stock reamers have enough metal to give long wear while cutting oversize holes, and they also permit of being ground down, if necessary, for becoming suitable to finish the finer grade holes. In Germany, the reamers technically and economically most suitable for producing standard holes have thus practically attained the status of a national standard themselves, with consequent benefits to all parties.

Walker Secretary of A.S.S.E.

In the announcement of the appointment of A. R. McGonegal as representative of the American Society of Sanitary Engineering on the ASA Standards Council, published on page 99 of the March issue of the ASA BULLETIN, it was erroneously stated that Mr. McGonegal is secretary of the A.S.S.E. Mr. McGonegal is a past secretary and he has also been president of the A.S.S.E. for two terms. James R. Walker, City Hall, Waterbury, Connecticut, is now secretary of the Society.

Representative on ASA Committee

K. J. T. Ekblaw, Oak Park, Illinois, has been appointed representative of the American Society of Agricultural Engineers on the Sectional Committee on Zinc Coating of Iron and Steel (G8), to succeed Channing Turner, formerly A.S.A.E. representative on the committee.

New Chairman of A.M.S.C.

H. Gerrish Smith, president, National Council of American Shipbuilders, has been appointed chairman of the American Marine Standards Committee, which is represented on many of the sectional committees under ASA procedure.

Foreign Standards Available from ASA

The following are new foreign standards available to Sustaining-Members for loan or purchase through the ASA office. In requesting copies of the standards it is necessary to list only the ASA serial numbers preceding the titles. Send either a plain post-card or a note containing only the name and address of the person wishing to receive the standards and the numbers of the standards desired. The card or envelope should be addressed to the American Standards Association, 29 West 39 Street, New York.

ASA Serial Number

France

116. Brake linings for automobiles
117. Carburetor for internal combustion engines, two bolts, flanges, controlling rod
118. Control pedals and levers for automobiles, positions and movements
119. Cylindrical box instruments for automobile engines, mounting diameters
120. Flexible shafts for tachometer, speedometer, etc.; connections
121. Screwed caps for radiators and tanks for automobiles, screwings and internal diameters
122. Spark plugs for internal combustion engines, 26 mm width across flats, dimensions and mounting

Australia

123. Distilled water and sulphuric acid for use in secondary batteries
124. Methods of sampling and testing soft solders and cored solder

Austria

125. Letting of contracts for building construction
126. Reinforced concrete, steps for stairs
127. Surface structures, working stresses for wood
128. Windows with posts and frames
129. Windows with post stock and outside rabbet moulding

Belgium

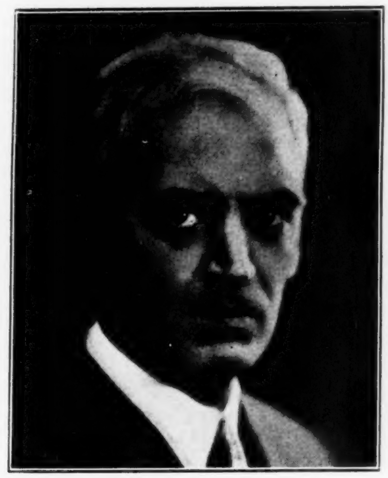
130. Standard specifications for electric machinery and transformers

Czechoslovakia

131. Laboratory glassware
132. Metric screw threads, series A, automotive industry

Parker Member of ASA Board of Directors

John C. Parker, president of the Brooklyn Edison Company, has been elected as representative of the Electric Light and Power Group on the Board of Directors of the American Standards Association. Mr. Parker succeeds M. S. Sloan, whose term as a member of the Board representing the Electric Light and Power Group expired in December, 1931.



John C. Parker

Mr. Parker has been a member of the ASA Standards Council representing the American Institute of Electrical Engineers for several years, and was vice chairman of the Council for the year 1931 and until his resignation in March, 1932. He has also been a member of the ASA Committees on Representation and on Procedure.

Changes in ISA Council

Professor V. List, chairman of the Czechoslovakian national standardizing body, has been elected president of the International Standards Association for the term 1932 to 1934, inclusive, to succeed C. Hoenig, representative of the Swiss national standardizing body. The national standardizing bodies of Austria and Poland have been elected to appoint representatives on the ISA Council for the period 1932–1934, inclusive, to succeed the representatives of France and Holland, in accordance with the regular schedule of rotation laid down in the ISA By-Laws. The countries now represented on the ISA Council are: Austria, Denmark, Italy, Poland, Russia, the United States.

Statement on Submittal of Commercial Standards to ASA

The National Bureau of Standards and the American Standards Association have jointly prepared a statement on the submittal for ASA approval of Commercial Standards established by trade and industrial groups under the auspices of the Division of Trade Standards of the Bureau. This statement, which is intended primarily for the assistance of the individuals and organizations participating in the formulation of Commercial Standards, follows:

Commercial Standards are developed by individual industries to serve as a nationally-acceptable basis for marketing their individual commodities in order that the producer may have a basis for certification of quality and that the distributor and consumer may both have a definite basis for justifying complaint on unsatisfactory material.

It frequently occurs that different commercial standards in the same broad field may recommend conflicting nomenclature, requirements, or methods of test since the procedure for the establishment of these standards provides no direct means for coordination between the various industries, except in so far as each may voluntarily accept the practices of other industries within its own broad field; such as, for example, textiles.

The American Standards Association, organized in 1918, has as one of its most important functions the duty of coordinating standards so as to avoid conflict and to determine the status of such standards in relation to the entire field of standardization. In order that each individual standard may assume its proper place in the broader structure of standardization for all industries, it is desirable that any conflicts or discrepancies be discovered and remedied as far as practicable.

At present, the Association is a federation of 43 national technical societies, trade associations, and departments and establishments of the Federal Government. Actions with respect to the formulation of rules for the determination of status of standards are governed by a Standards Council consisting of representatives of all the Member-Bodies. To this Standards Council is entrusted the duty of approving standards which are to be known as "American Standards."

In order that the work on Commercial Standards may be properly coordinated with other standardization activities being carried out in various American industries and their value be more generally appreciated, and in order that duplication of work and the promulgation of conflicting standards may be avoided, certain of the Commercial Standards, at the specific request of the industries concerned, are being submitted to the American Standards Association for approval as American Standards.

Each industry should, of course, determine for itself whether its standards should be submitted to the American Standards Association for this coordination process and in the event it desires to do so, some trade association or technical society should be ready to stand as sponsor for the project before the ASA. In the event the industry desires to have a given commercial standard submitted for approval as an American Standard and has no organized group which may properly assume sponsorship, the Bureau of Standards will, on request, serve as sponsor for such project.

A.S.T.M. Publishes 1931 Proceedings

The American Society for Testing Materials recently published its *Proceedings*, Volume 31, for the year 1931. As has been customary for several years, the latest volume appears in two parts, totaling more than 2100 pages. Both parts are indexed in a comprehensive manner. Each part of the *Proceedings* is available from the Society's headquarters at the following prices: paper binding, $5.50; cloth binding, $6; half-leather, $7.

Part I of the *1931 Proceedings* contains the annual reports of the Society committees and the papers and standards appended thereto. The president's annual address and the annual report of the Executive Committee are also included. Reports of 42 standing and research committees, and reports of one joint and two sectional committees appear in this part. These reports cover fields of ferrous and non-ferrous metals; building and other non-metallic materials; and also, among others, petroleum products and lubricants, road and paving materials, coal and coke, rubber and textile products. Accompanying these committee reports are many papers discussing research investigations in their several fields. There are also included, in order to give as complete a picture as possible of committee activities, 74 tentative standards adopted and published in 1931 for the first time. Several tentative revisions in standards are also included.

Technical papers which were given at the Annual Meeting of the Society in June, 1931, appear in Part II of the *1931 Proceedings*. Under the general heading of metals, many valuable papers covering various aspects of fatigue, endurance testing, magnetic analysis, damping capacity, and corrosion of metals are included.

A Symposium on Malleable Iron Castings presents authoritative data on the properties of these types of castings and discusses methods for determining the machineability of malleable iron castings and also the corrosion of malleable iron. Another section includes papers on concrete and concrete masonry, and also structures made from such materials. Among the topics included are freezing and thawing of concrete aggregates, mixing, temperatures in mass concrete, and resistance of fire clay brick to thermal spalling. A Symposium on Weathering Characteristics of Masonry Materials comprises another section and presents results of recent researches, together with a bibliography and abstracts. Abrasion testing of rubber was covered by several papers on recent investigations. Five papers and the discussion on them given in the Symposium on the Economic Significance of Specifications for Materials, cover a topic of great importance to all executives in American industry.

H. M. L.

Heating and Ventilating Guide Published

The American Society of Heating and Ventilating Engineers has published its 1932 *Engineers' Guide*, copies of which may be obtained from the Society's office at 51 Madison Avenue, New York, at $5.00 per copy. A review copy of the book is available for loan to Sustaining-Members of the American Standards Association through the ASA office.

The *Guide* contains complete and up-to-date information on heating, ventilating, and air conditioning for the use of engineers, contractors, and others engaged in heating and ventilating work. It is written in a clear, easily understandable style and contains numerous illustrations, charts, and tables. There are four major sections in the *Guide*, the text section, containing 552 pages, the manufacturer's catalog data section, the index to modern equipment, and the membership roll of the Society of Heating and Ventilating Engineers. The comprehensive nature of the text section may be judged from the following list of chapter headings: definitions and abbreviations; estimating heat losses; heat transfer through materials and constructions; air leakage from buildings; gravity warm air heating systems; radiators; gravity convectors; hot water heating systems and pipe sizes; steam heating systems and pipe sizes; devices for handling condensate and air; pipe, fittings, valves and pipe welding; pipe insulation; domestic water requirements and pipe sizes; heating boilers; draft and chimneys; fuels; mechanical stokers; oil burners; gas heating appliances; heating with electricity; heating with exhaust steam; district heating; automatic temperature control; ventilation of public buildings; ventilation of industrial buildings, exhaust systems; natural ventilation; principles of air conditioning; air conditioning in relation to comfort and health; air conditioning for industrial processes; air conditioning apparatus; central fan systems; air distribution systems; air cleaning devices; fans and motive power; industrial unit heaters; unit ventilators; unit air conditioners and coolers; smoke, dust, and cinder abatement; physical data; general information.

German Standards for Water Tubes and Stay Tubes for Boilers

The German Boiler Committee has recently published Recommendations for Water Tubes and Stay Tubes, copies of which are on file in the ASA office. This document gives specifications for the quality of the seamless steel tubes used for the purpose in question, including material and test specifications, method of inspection, tolerances on outside diameter and wall thickness, and the several tests to which the finished tubes should be subjected. The formula on which the calculation of the wall thickness of the tubes is to be based is also given in the pamphlet.

S. B. Flagg Vice Chairman of Committee on Coal Classification

The late Walter R. Addicks, who is listed as a member of the sectional committee on Classification of Coals (M20) in an article on the activities of the sectional committee which appeared on page 109 of the March issue of the ASA BULLETIN, was succeeded by S. B. Flagg, fuel engineer, Electric Bond and Share Company, New York, as vice chairman of the committee and representative of the National Electric Light Association.

A.S.T.M. Committees Meet

Twenty committees of the American Society for Testing Materials, including several sectional committees working under the procedure of the American Standards Association, participated in the series of annual Spring Group Meetings of the A.S.T.M. in Cleveland from March 7 to 11. About 400 registered for the meetings. Several of the committees offered new standards and revisions of existing standards.

ASA PROJECTS

Transportation, Ferrous Metallurgy, and Non-Ferrous Metallurgy Projects

The sixth of a series of reviews of standardization projects under the procedure of the American Standards Association

The status of all projects concerning transportation, ferrous metallurgy, and non-ferrous metallurgy projects under ASA procedure is summarized in the following review. The data presented are taken from the files of the American Standards Association and are corrected to March 1, 1932, bringing up-to-date the review of projects published in the April, 1931, issue of the ASA BULLETIN. The personnel of the sectional committees handling the projects may be found by reference to the project section of the 1931 American Standards Association *Year Book* (pages 58–63).

E2-1923—Design for Joint Plates for Seven-Inch Girder-Grooved and Guard Rails

Sponsor—American Electric Railway Association.

Scope—Design for bolted joint plates to be used with the standard seven-inch girder-grooved and girder-guard rails, for electric railway track construction.

E3-1923—Design for Joint Plates for Nine-Inch Girder-Grooved and Guard Rails

Sponsor—American Electric Railway Association.

Scope—Design for bolted joint plates to be used with the standard nine-inch girder-grooved and girder-guard rails, for electric railway track construction.

E4-1923—Design for Seven-Inch Girder-Grooved Rail

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for a medium weight seven-inch girder-grooved rail, for electric railway track construction.

E5-1923—Design for Nine-Inch Girder-Grooved Rail

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for a medium weight nine-inch girder-grooved rail, for electric railway track construction.

E6-1923—Design for Seven-Inch Girder-Guard Rail

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for the girder-guard rail to be used on curves in conjunction with the standard seven-inch girder-grooved rail, for electric railway track construction.

E7-1923—Design for Nine-Inch Girder Guard Rail

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for the girder-guard rail to be used on curves in conjunction with the standard nine-inch girder-grooved rails, for electric railway track construction.

In 1923 the American Electric Railway Association submitted standards for the above group of projects, E2 to E7, inclusive. After consideration by a subcommittee, these standards were approved as American Standards and the A.E.R.A. appointed sole sponsor. In February, 1931, ASA was advised that revisions were under consideration for E4, E5, E6, and E7. In June, 1931, advice was received indicating that certain additional minor revisions might be found necessary. ASA has now been advised that favorable action upon these revisions has been taken by the A.E.R.A. as a result of a letter ballot canvass of the member companies. The submittal of the revised standards is expected shortly.

E8-1926—Design for Seven-Inch 82-Lb Plain Girder Rail and Splice Bar for Use in Paved Streets

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for a seven-inch, 82-pound plain girder rail to be used under medium traffic conditions, in conjunction with deep block pavement—for electric railway track construction; and including design of joint plates suitable for use with such rails.

E9-1926—Design for Seven-Inch 92-Lb Plain Girder Rail and Splice

Bars for Use in Paved Streets

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for a seven-inch 92-pound plain girder rail to be used under heavy traffic conditions, in conjunction with deep block pavement—for electric railway track construction; and including design of joint plates suitable for use with such rails.

E10-1929—Specifications for Special Track Work Materials

Sponsor—American Electric Railway Association.

Scope—These specifications are intended to cover the manufacture, chemical and physical properties, and tests of materials entering into the manufacture and assembly of special trackwork for steam, electric, and industrial tracks of all gages and types, for heavy rail of 50 lb per yard and over, under any motive power, and in either open or paved track.

E11-1926—Design for Seven-Inch 102-Lb Plain Girder Rail and Splice Bars for Use in Paved Streets

Sponsor—American Electric Railway Association.

Scope—Design, covering weight and dimensions, for a seven-inch, 102-lb plain girder rail to be used under heavy traffic conditions, in conjunction with deep block pavement—for electric railway track construction; and including design of joint plates suitable for use with such rails.

Standards for projects E8 to E11, inclusive, were developed by a sectional committee organized in 1923 by the American Electric Railway Association, sponsor for these projects. ASA approved E8, E9, and E11 in 1926, and E10 in 1929, all as American Tentative Standards.

As mentioned above for standards E2 to E7, inclusive, E8, E9, and E11 have also been undergoing revision. It is expected that the revised standards will shortly be submitted to ASA for approval, as the member companies of the A.E.R.A. have recently sanctioned their adoption.

G8—Specifications for Zinc Coating of Iron and Steel

Sponsor—American Society for Testing Materials.

Chairman—J. A. Capp, chief of testing laboratory, General Electric Company, Schenectady, N. Y.

Secretary—A. B. Campbell, National Electric Light Association, New York.

Scope—Development of nationally uniform specifications for the adequate protective coating of different classes of zinc-coated products, including: outside electrical construction; inside electrical construction, including conduits; sheets and plates and products fabricated therefrom, for outside use; sheets and plates and products fabricated therefrom, for inside use; water pipes and associated valves and fittings; agricultural implements, tools, and small general hardware; marine hardware and ship fittings; rivets, bolts, nuts, screws, and nails; structural shapes; fencing materials and woven wire cloth; and including all forms of zinc coating for iron and steel—hot galvanizing, sherardizing, electroplating, spray coating—and methods for the test of all such coatings.

Originally initiated as a result of a more or less general demand for the development of comprehensive specifications for zinc coating of iron and steel, the organization of a representative sectional committee under the sponsorship of the A.S.T.M. was approved by ASA some years ago. From its inception the work of this committee has been closely correlated with research and standardization programs of other groups active in this field, such as the A.S.T.M., the electric light and power interests, the telephone system, etc. The drafting of standards has been in the hands of several technical committees whose recent activities are given below. Two standards, Zinc (Hot-Galvanized) Coating on Structural Steel Shapes, Plates and Bars and Their Products (G8c-1930; A.S.T.M. A 123-30) and Specifications for Zinc-Coated (Galvanized) Sheets (G8b1-1931; A.S.T.M. A 93-27) have been approved, and drafts for several others are under consideration by the subcommittees.

G8a—Technical Committee I—Hardware and Fastenings. A. L. Fox, *chairman.* This technical committee has been engaged upon an investigation of the weight and uniformity of zinc coatings through the collection of representative samples of zinc-coated products and their subsequent laboratory study.

Several drafts of proposed specifications for hot-dipped galvanized hardware products have been prepared and considered but, as the requirements of some of the different groups are dissimilar, agreement upon the technical provisions has not been reached. It is reported that future activities of this technical committee will include the preparation of specifications for sherardized, electro-galvanized, and Schoop process coating.

G8b—Technical Committee II—Sheets and Sheet Products. G. A. Reinhardt, *chairman.* After recommending to the sectional committee in 1930 that Specification for Zinc-Coated (Galvanized) Sheets (A.S.T.M. A 93-27) be submitted to ASA for approval as American Tentative Standard (approved by ASA as noted above in June, 1931), no further proposals have been made by this technical committee.

G8c—Technical Committee III—Structural Steel Shapes, Plates, Bars, and Their Products. V. F. Hammel, *chairman.* The personnel of Technical Committee III overlaps that of Subcommittee X on Embrittlement Investigation of A.S.T.M. Committee A-5 on Corrosion of Iron and Steel. Subcommittee X, jointly with the Utilities Research Commission, is directing a

study at the Battelle Memorial Institute on the embrittlement of structural steel in the galvanizing process. Progress reports from this research have been made from time to time. The final report will be available to this technical committee for consideration in connection with certain provisions on embrittlement of galvanized products in the American Tentative Standard on Zinc (Hot Galvanized) Coatings on Structural Steel Shapes, Plates, and Bars and Their Products (G8c-1930).

G8d—Technical Committee IV—Pipe Conduits and Their Fittings. C. J. Krieger, *chairman.* During the past two years this technical committee has considered several drafts of proposed specifications for zinc-coated pipe. Late in 1931 one of these specifications, Zinc Coating of Pipes, Conduits, and Their Fittings (A.S.T.M. A 120-28 T), was recommended to the sectional committee for submittal to ASA. As a result of a letter ballot of the sectional committee, it was determined that the specifications, particularly in the sections that dealt with the character of the zinc coating, were not sufficiently definite, so the technical committee is now engaged upon preparation of new sections to replace those to which objections have been taken.

G8e—Technical Committee V—Wire and Wire Products. J. L. Schueler, *chairman.* In conjunction with Subcommittee VI on Specifications for Metallic-Coated Products of A.S.T.M. Committee A-5 on Corrosion of Iron and Steel, several specifications within the scope of this committee have been drafted and adopted by the A.S.T.M. as standards or tentative standards. Consideration has been given to submitting the Standard Specification for Zinc-Coated (Galvanized) Steel Wire Strand (A.S.T.M. A 122-30) to ASA for approval as American Tentative Standard. However, as certain objections have been raised, a special subcommittee was set up a year ago to study all of the wire and wire product specifications prior to taking action on the question of their submittal to ASA.

G8f—Technical Committee VII—Methods of Testing. E. S. Taylerson, *chairman.* This committee also functions as Subcommittee VII on Methods of Testing of A.S.T.M. Committee A-5 on Corrosion of Iron and Steel. The activities of these committees, which were reorganized in 1930, have been largely concerned with requests for new investigations on methods of testing. Study is being given to the possibility of developing a laboratory test for zinc-coated products that will simulate the conditions the materials will have to undergo in service. Although a large amount of work has been carried on, results so far obtained have not been encouraging. Contact is being maintained with Subcommittee VIII on Field Tests of Metallic Coatings of A.S.T.M. Committee A-5 on Corrosion of Iron and Steel which is carrying on atmospheric tests of metallic-coated materials in different sections of the country. Study is also being given to methods that are available for determining the weight of coating on zinc-coated articles.

G9—Specifications for Carbon-Steel and Alloy-Steel Blooms, Billets, and Slabs for Forgings

Sponsor—American Society for Testing Materials.

Scope—Specifications for general commercial purposes covering blooms, billets, and slabs of carbon and alloy steel destined for forgings and to be purchased as semi-finished rolled or forged material, covering carbon and alloy steels (nickel, chrome-nickel, chrome, and chrome-vanadium steel), their classification and grades, manufacture, chemical properties and tests, workmanship and finish, marking and rules governing inspection and rejection.

This standard was submitted by the American Society for Testing Materials as an existing standard and approved by ASA as an American Tentative Standard in 1924. A revision of the standard was submitted by the A.S.T.M. in 1929 for approval as a proprietary standard. Action on this case is awaiting the completion of an exhibit, required according to ASA procedure, in support of the submission.

G12-1931—Specifications for Refined Wrought-Iron Bars

G13-1931—Specifications for Wrought-Iron Plates

Sponsor—American Society for Testing Materials.

The two specifications above (A.S.T.M. A 41-30 and A 42-30, respectively) were submitted by the American Society for Testing Materials as existing standards and approved by ASA as American Tentative Standards in 1923.

In 1930 both specifications were revised by the A.S.T.M., the revision consisting in the incorporation of a definition for wrought iron, and the elimination of reference to puddling. The revised specifications were submitted by the A.S.T.M. as proprietary standards and approved by ASA as American Tentative Standards in 1931. The A.S.T.M. was appointed proprietary sponsor.

H1—Zinc and Zinc Ores

Sponsor—American Society for Testing Materials.

Chairman—W. H. Bassett, technical superintendent, American Brass Company, Waterbury, Conn.

Secretary—G. C. Stone, chief metallurgist, New Jersey Zinc Company, New York.

Scope—The definition of grades of spelter; gages and tolerances for sheet zinc; physical tests for sheet zinc; methods of chemical analysis of zinc and zinc ores, and methods of sampling and weighing.

Due to the unsettled condition of the zinc industry, brought about by the marked expansion of the production of metallic zinc, there are differences of opinion regarding the quality of the various grades of zinc and the methods of analysis. Although the submittal of specifications (A.S.T.M. B 6-18) to ASA has been considered, definite action has been deferred pending further technical developments.

H4-1928—Specifications for Soft or Annealed Copper Wire

H14-1929—Specifications for Hard-Drawn Copper Wire

Scope—These specifications cover copper wire suitable for use as electrical conductors and for mechanical purposes but exclude copper trolley wire.

H15—Specifications for Medium Hard-Drawn Copper Wire

Scope—These specifications cover medium hard-drawn copper wire suitable for electrical conductors and for mechanical uses.

H16-1928—Specifications for Tinned Soft or Annealed Copper Wire for Rubber Insulation

Sponsor—American Society for Testing Materials.

Chairman—J. A. Capp, chief of testing laboratory, General Electric Company, Schenectady, N. Y.

Scope—These specifications cover tinned soft or annealed copper wire suitable for use in making rubber insulated wires and cables.

In connection with the four projects listed above, which are all under the supervision of one sectional committee, standards have been approved for H4 (A.S.T.M. B 3-27), H14 (A.S.T.M. B 1-27), and H16 (A.S.T.M. B 33-21). The specifications for project H15 (A.S.T.M. B 2-27) were submitted some years ago but were unacceptable to the Light and Power Group and have not been resubmitted as yet. Specifications for Tinned Soft or Annealed Copper Wire for Rubber Insulation (H16-1928), and Specifications for Soft or Annealed Copper Wire (H4-1928) have been used as basic wire standards by the sectional committee for project C8, Specifications for Insulated Wires and Cables (Other than Telephone and Telegraph), and have also been published under the designations of C8b1 and C8b2, respectively.

H7-1925—Specifications for Brass Forging Rod

Sponsor—American Society for Testing Materials.

Scope—Specifications for brass forging rods capable of being readily forged hot and easily machined; their manufacture, chemical properties and tests, physical properties and tests, permissible variations in dimensions, workmanship and finish, and rules governing inspection and rejection.

This standard (A.S.T.M. B 15-18) was submitted by the A.S.T.M. as an existing standard and approved by ASA as an American Tentative Standard in 1925.

H8—Specifications for Free-Cutting Brass Rod for Use in Screw Machines

Scope—Specifications for free-cutting brass rods suitable for high-speed screw machine work; their manufacture, chemical properties and tests, physical properties and tests, permissible variations in dimensions, workmanship and finish, and rules governing inspection and rejection.

The standard (A.S.T.M. B 16-29) was submitted by the American Society for Testing Materials as an existing standard, and approved by ASA in 1925 as an American Tentative Standard, the A.S.T.M. being appointed sole sponsor. In 1929 the A.S.T.M. submitted a revision of the standard for approval as a proprietary standard. ASA has deferred action pending the submission of further information by the A.S.T.M. regarding the development of the specifications.

H11-1924—Specifications for Solder Metal

Sponsor—American Society for Testing Materials.

Scope—Specifications for lead-tin alloys used for solder metal, commercially known as soft solder, in various classes and grades; their manufacture, chemical properties and tests, commercial sizes or shapes, marking and rules governing inspection and rejection.

This specification (A.S.T.M. B 32-21) was submitted by the American Society for Testing Materials as an existing standard and approved by ASA in 1924 as an American Tentative Standard. The A.S.T.M. was appointed sole sponsor.

H13-1925—Outside Dimensions of Plumbago Crucibles for Non-Tilting Furnaces in Non-Ferrous Foundry Practice

Sponsors—American Foundrymen's Association; Plumbago Crucible Association.

Scope—Standardization of size numbers and dimensions of plumbago crucibles for use in casting brass and other non-ferrous metals in connection with non-tilting furnaces.

The Plumbago Crucible Association submitted this standard as an existing standard. It was approved by ASA in 1925 as an American Tentative Standard with the above organizations as joint sponsors.

H17—Specifications for Lake Copper Wire Bars, Cakes, Slabs, Billets, Ingots, and Ingot Bars

H18—Specifications for Electrolytic Copper Wire Bars, Cakes, Slabs, Billets, Ingots, and Ingot Bars

H19—Specifications for Sheet High Brass

H20—Specifications for Manganese Bronze Sand Casting

H21—Specifications for Manganese Bronze Ingots for Sand Castings

Of the specifications listed above, earlier editions of H17 (A.S.T.M. B 4-27), H18 (A.S.T.M. B 5-27), and H19 (A.S.T.M. B 36-27) had approval as American Tentative Standard, but subsequent to a revision by the A.S.T.M. in 1927 approval of these specifications was withdrawn by ASA. In 1929, these five specifications, including H20 (A.S.T.M. B 54-27) and H21 (A.S.T.M. B 7-27), were submitted by the American Society for Testing Materials for approval as American Standard under the proprietary method. More recently, projects H17 and H18 were submitted to the ASA Board of Examination for recommendations to Standards Council with regard to their approval as American Standard.

Noise Measurement Project Approved by ASA

The initiation of a project on Noise Measurement (Z24) under the procedure of the American Standards Association, has been approved by the Standards Council of ASA. The Acoustical Society of America has been designated sponsor for the project.

This action was recommended to ASA by a conference of representatives of 18 national organizations, following the request of the Acoustical Society of America that a national committee be set up to correlate the activities of various technical and trade organizations which have been attempting individually to set up standards for noise measurement.

The scope of the project as recommended to ASA by the conference is as follows:

> Preparation of general standards of nomenclature, units, scales, and measurement in the field of acoustics, with special reference to noise measurements.

It is expected that a sectional committee to work under the procedure of the American Standards Association will be organized in the near future.

An account of the preliminary conference which recommended the initiation of the project to ASA was published on page 81, ASA BULLETIN, February, 1932.

ASA Approves Project on Surface Quality

The ASA Standards Council has decided that work on the project Classification and Designation of Surface Qualities shall be undertaken by a sectional committee (B46) under the joint sponsorship of the American Society of Mechanical Engineers and the Society of Automotive Engineers. Both of these organizations have offered to serve as sponsors and they have now been invited to organize the sectional committee. This is done, under ASA procedure, by inviting all organizations having an important interest in the new project to appoint representatives.

The launching of this project is the result of a request submitted to ASA by the A.S.M.E. to have work undertaken on standard finishes of machine surfaces. This request was referred for advice to a special committee, under the chairmanship of Major William B. Hardigg, U. S. War Department (see ASA BULLETIN, November, 1931). This committee unanimously recommended the above-mentioned action to the ASA Standards Council.

In its report, the special committee stated that it had found an immediate need existing for the standardization of classification and designation of surface qualities of machined metal surfaces and ground metal surfaces. It therefore recommended that the development of standards in this field be given priority by the sectional committee which would be organized. The suggestion was made, in the report, that this important division of the work might be formulated as the "classification of machined or ground surfaces according to quality of finish" and that there be developed in this respect:

(*a*). Standards of quality of finish for machined surfaces

(*b*). Standards of quality of finish for ground surfaces

(*c*). Method of inspection for the quality grades standardized

(*d*). Designation of quality grades for use in specifications and on drawings

The special committee also found that there was a decided interest on the part of certain lines of industry for standards of quality for finishes produced by fabricating processes other than machining and grinding, such as casting, rolling, drawing, forging, etc., and also for finishes produced by hand tools.

Furthermore, the special committee agreed that it was not desirable to recommend that the scope of the project be limited to quality of finishes produced on metal surfaces. In fact, the establishment of standards for the surface quality of parts made of bakelite, glass, hard rubber, etc., may also appear to be desirable.

While, therefore, the immediate need evidently mainly concerns machined and ground surfaces, the special committee recommended a formula for the general scope of the work that is wide enough to permit the sectional committee to take up the additional items referred to above, if it so desires. (A formula of scope defines the field which a sectional committee *may*, but not necessarily *must*, cover.) This general scope is worded as follows:

"Classification and designation of surfaces according to quality of surface."

(This wording does not tie the work to the process by which the surfaces in question have been produced, nor to the materials to which they belong, metal or otherwise.)

Due to the many and varied interests involved, the special committee also recommended that the final wording of the scope of the project be left to the sectional committee now to be organized. If the proposed scope is found to be acceptable by the sectional committee, the title of the project may accordingly, the special committee suggested, be stated as follows: "Classification and designation of surface qualities."

J. G.

Codes for Prevention of Dust Explosions Published

A group of nine American Standards relating to dust explosions in various industries have just been published by the U. S. Bureau of Labor Statistics as its Bulletin number 562. Copies may be obtained directly, or by mail through the ASA office, at 15 cents each. The following American Standard Safety Codes are included in the Bulletin:

Installation of pulverized fuel systems (Z12a-1930)

Pulverizing systems for sugar and cocoa (Z12b-1931)

Prevention of dust explosions in starch factories (Z12c-1931)

Prevention of dust explosions in flour and feed mills (Z12d-1928)

Prevention of dust explosions in terminal grain elevators (Z12e-1931)

Prevention of dust explosions in coal pneumatic cleaning plants (Z12f-1930)

Prevention of dust explosions in wood flour manufacturing establishments (Z12g-1931)

Prevention of dust ignitions in spice grinding plants (Z12h-1931)

Use of inert gas for fire and explosion prevention (Z12i-1931)

Draft on Lock Washers May Be Borrowed

A draft of the standard for lock washers has been prepared by the subcommittee of the technical committee in charge of the project, Plain and Lock Washers (B27). The draft is being circulated for criticism and review. It contains a table of proposed sizes for lock washers together with tolerances.

Work on this project is going forward under the sponsorship of the A.S.M.E. Copies of the draft standard may be borrowed from the office of the American Standards Association.

Standards Suggested to Aid Silk Hosiery Industry

In order to put the silk hosiery industry on a more stable basis and correct some of its industrial ills, William Baum, industrial engineer of the Real Silk Hosiery Mills, writing in the *Melliand Textile Monthly*, has proposed fourteen points of improvement, of which five relate directly to standardization; as follows:

Uniform standards of the product

Uniform standards of quality (grading of finished goods)

Simplification of ranges of product

Uniform methods of cost-accounting

Centralization of buying, testing, and research agencies